SCIENTIFIC AMERICAN

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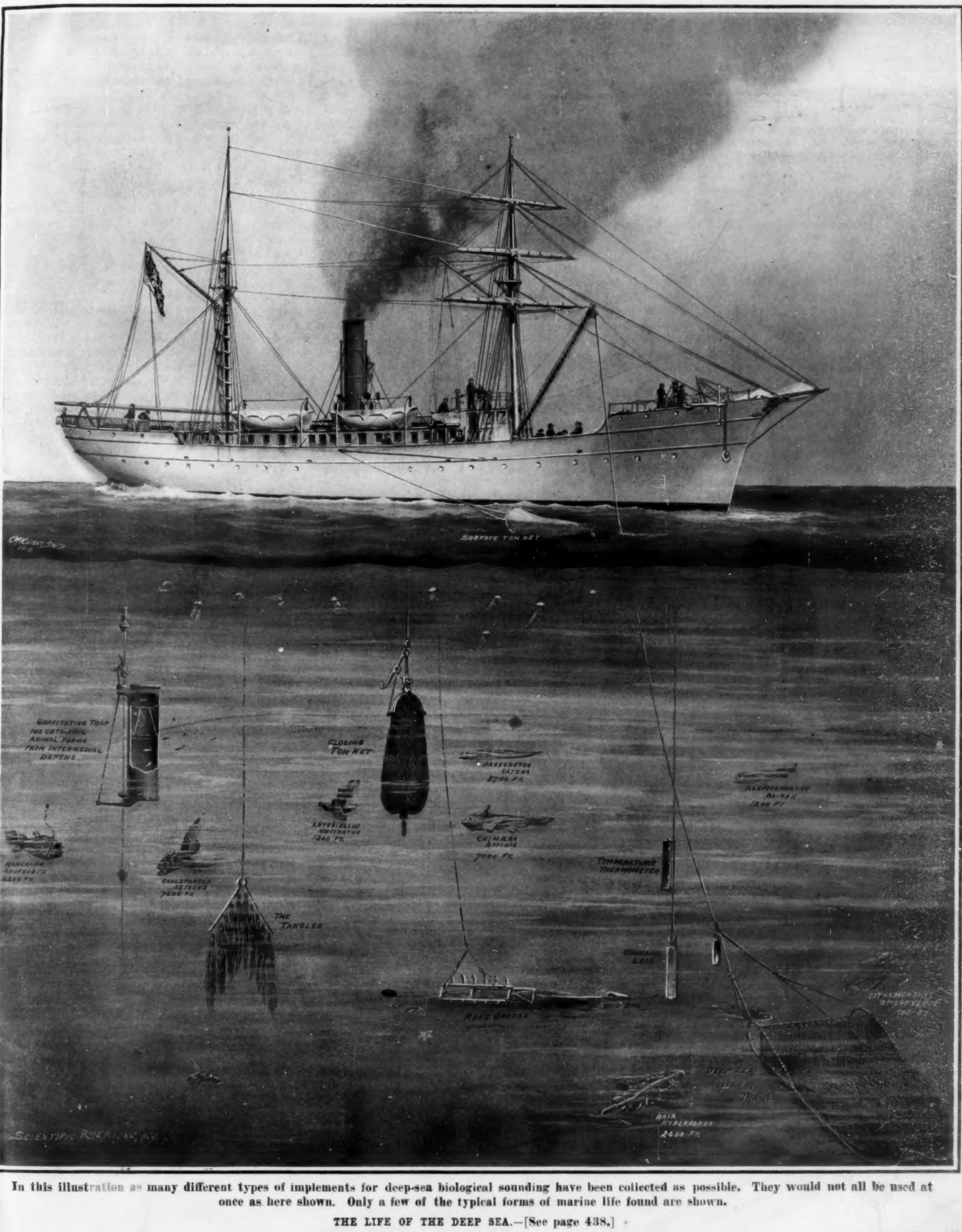

In this illustration as many different types of implements for deep-sea biological sounding have been collected as possible. They would not all be used at once as here shown. Only a few of the typical forms of marine life found are shown.

THE LIFE OF THE DEEP SEA.—[See page 438.]

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

JOHNSTONE'S FATE AND ITS LESSON.

THE annals of the flying machine now number among their tragedies one fatality that is different from all that preceded it, a fatality certainly the most pathetic and the most gruesomely detailed. If a catastrophe may be unsentimentally regarded as instructive, the fate of Johnstone should teach us much; for it involved a machine that has shown itself more positive in its action than almost any other, and an aviator who, by flying in a wind of over seventy miles an hour with safety, has shown himself superior to all his colleagues, with the exception of Hoxsey, who flew in the same storm, but did not stay up as long. Johnstone was not destroyed with that swiftness which characterized most previous accidents. Usually no one knows what happened in the air. A mangled body is taken from a mass of wreckage, and we can only guess what caused the accident. Johnstone's case was more like the stranding of a boat on a rocky shore in a rough sea, with all its pitiful stages and developments. It emphasizes the "nautical" or shiplike character of the new tail-controlled Wright model in the hands of an "air sailor" like Johnstone.

Unlike any other accident of its kind, this catastrophe occurred at the considerable height of about 800 feet. It showed that in free air an aeroplane becomes so far buoyant that even when disabled, it is not utterly without support, an effect which, of course, is rather deceptive. Just as the flying speed of an aeroplane is hopelessly underestimated by the eye, if the plane is at a distance and high in the air, so the actual speed of falling in an accident is easily belittled. The eye readily follows the distant machine. Some time elapses between the first loss of balance and the final crash. Moreover, the exposed, stagelike appearance of a machine in the air conceals few of the gruesome details.

What really happened is now fully understood. It is the old story of the miner blown to pieces by the dynamite, which he was warming in his bootlegs, the old story of "familiarity breeding contempt." It is easy to err in estimating the comparative importance of an aeroplane's members. The big, clumsy, primitive structure of the plane seems of secondary importance, like the tonneau of an automobile, like the hull of a boat. The mechanical devices, however, inspire one with awe. It should be exactly the reverse. The motor may fail, a propeller may split without danger, if the pilot is skilled; but the breaking of one rib near the outer end of a wing spells certain death.

The struts connecting the surfaces of a biplane are so many vital organs, comparable indeed with the spinal cord and ribs in a human body. Any damage to the struts up in the air means the crippling of the balancing devices, and the end of all aerial support. Fortunately, such an accident in the air is rather unlikely to occur, however frequently it may happen on the ground. When a machine has been weakened by collision with the ground, as in this case, and is later strained in the air by sudden turns and gyrations, the pilot is in danger. Johnstone, who had probably glided down at too high a forward speed in the thin air of Denver, did not stop rolling soon enough, and ran into a fence before his fatal accident occurred. It is easy to conceive that he instinctively expected the same braking effect from the air next to the ground that he had experienced at lower altitudes in the East. Also the effect of landing on wheels may still have been new to him after having handled Wright machines fitted with skids so long. That the thin air near the ground in Denver (one mile high) confused his judgment in landing is shown beyond doubt by the fact that he broke his wheels in coming down on the occasion mentioned. For a pilot of his experience and skill, this is extraordinary. Running into the fence, he fractured the outermost struts on the right side.

Conditions at present flying meets call for quick repairing of damaged machines. Johnstone should have substituted entirely new struts for those injured. Instead, he had them "set" and glued and strengthened by iron rings, which were very poorly held in place by ordinary nails, passing through holes in the ring larger than the nails' heads, a mistake made in hasty repairing. The straining of the struts while the wings were twisted, and the vibration of the motor, caused the nails to work out of the ring holes, and the ring to work loose and slip from its original position. Then came a quick turn of short radius with an energetic use of the wing tips. The repaired strut collapsed (part of it fell from the air and was picked up by a boy) and the right wing ends flapped helplessly in the air. It is deeply pathetic to learn how Johnstone tried to restore balance by bringing the left wing down with the control, just as a man who is collapsing on a broken right leg would try to prevent himself from falling by bending his sound left leg also; how in sheer desperation he tried to force the twisting on the right side; how he succeeded for a moment, but how utterly hopeless this maneuver was, which deprived him of the use of the left side control and of the fore and aft control. Thence to the complete loss of balance and of speed and to the final chute was only a step. But how heroic was this struggle aboard an aeroplane disabled, but still half afloat. The last fall from 300 feet occurred with vertiginous rapidity.

A remarkable air pilot was lost with Johnstone. The manner of his death emphasizes the need of safeguarding the man in the air. It is to be hoped that this tragedy will teach men to regard the surfaces of an aeroplane as more than mere secondary parts and to insist on thorough repairs.

STUDIES OF ROOT LIFE.

THE experts of the Bureau of Plant Industry of the Department of Agriculture are carrying on a most valuable work in their investigation of root life. Their root experiments with plants are the outcome of a study of the problems involved in wide and shallow planting, as opposed to close, ordinary planting. In the former method, a great root development would enable the farmer to do well with very little rain; in the latter, his reliance is entirely on rain.

Experimenters have hitherto been handicapped by the absence of a device properly to study root growth, but this difficulty has been overcome by a member of the Dakota station. He dug a trench two feet wide about a block of earth in which were growing some plants, the roots of which he desired to study. When the block stood out alone quite clearly he made a light wooden frame to fit around it and covered this with common wire poultry netting. This held the earth in place and enabled him to pierce it through with small wire rods, which were then fastened at both ends to the netting. When enough of these thin wire rods had been run through, to hold up the roots in case the earth was washed away, he covered the top of the ground with a thin plaster of Paris paste, which soon dried, holding the plants he desired to examine firmly about the base.

The subsequent stages of this process, which has been adopted by the Bureau experts, involve the washing of the earth from about the roots with soft, warm water, leaving them wholly exposed and suspended upon the wires which had been forced through the earth. It becomes easy then to lift the cage, with its plaster of Paris roof, holding the desired plants, to such a place as desired for study. Care is taken to dig the surrounding trench deep enough in the beginning to avoid the possibility of the roots being still connected with the earth below.

The root experimenters have met considerable difficulties. For one thing, the fine threadlike portions of the roots are destroyed at their extremities by the warm water washing. The threads, however, at the points where they ended, have been analyzed, and it has been found that even at this stage of the progress of the nourishment upward, the great chemical work, the taking from the soil of lime, sodium, nitrogen and the like, has been completed by the tiny filament. Somewhere, a little farther on in the soil which had been washed away, the work had been going on. It is the understanding of this process which is now desired, and which is apparently quite remote. Nevertheless, some valuable results have been already attained. Naturally, the investigations up to this time have concerned the plants most valuable to man—wheat and corn, potatoes, beans, and the like.

According to the Bureau's experts, roots seem to possess actual sentience in regard to their search for water. One of the interesting results of this investigation is that science can now determine which of the plants are deep feeding, and hence which are most suitable for dry, insufficiently water soils.

For instance, a species of wheat which had the power to dig six feet down in its search for food and moisture would be better adapted to the dry regions of the West than one that could dig but four. There are certain species of wheat that do splendidly in naturally soft, sandy soils, but whose roots are too weak to dig through heavy soils. This cannot be determined by simply pulling up a stalk. It requires such an investigation as this instituted by the government.

Anotner thing which has been proved by the investigation of root development is why land laid down to grass is made better. It has long been known that when the wild prairie is first broken the soil is mellow, moist, and rich, producing abundant crops. After a few years of continuous cultivation the physical condition of the soil changes. The soil grains become finer, which is bad; the soil becomes more compact and heavier to handle; it dries out more quickly than it used to; it balks worse, and often turns over in hard clods when plowed. This compact texture makes it difficult for the young roots of plants to develop properly. It also causes an insufficient supply of air in the soil and makes it sticky when wet, dusty, when dry, so that when loosened by the plow it is easily blown away. This is because it lacks roots of the right sort—stout, hardy, deep-reaching roots.

A little table of soil conditions has been prepared for regions in which these root investigations will be of special value; which will prove interesting and suggestive, because they may be modified to suit almost any region. It contains the fact that an acre of soil to the depth of one foot is estimated to weigh 3,225,000 pounds and then tabulates the facts, namely, that within the first foot of soil there are found: 6,772 pounds of phosphoric acid, 32,897 pounds of potash, 47,407 pounds of lime. Thus, within the reach of nearly every plant is found four times this sum per acre, for nearly all plants reach four feet downward with their roots. It is figured that this means enough phosphoric acid to supply the wants of 1,400 annual wheat crops and of the other constituents even more. The relation of this to the root investigations lies in the fact that no root shall be deprived for lack of ample plowing of free search among these chemicals for what it needs.

OCTAVE CHANUTE.

ALTHOUGH for some years Octave Chanute was not actively engaged in aerodynamic research, his death is a distinct loss not only to America, the land of his adoption, but to the engineering world as well. It is rarely indeed that even a scientific man has devoted himself so whole-heartedly and unselfishly to a wonderful cause without any promise of financial remuneration. Probably no authority on aviation has been so ready to assist the experimenter as Octave Chanute. Not only did he draw generously from his own rich store of experience and reading for the benefit of all who consulted him, but he even aided financially a few struggling inventors who had ideas of promise. How far the Wright brothers were benefited by his advice and his instruction it is hard to state. It is certain, however, that it was largely due to his encouragement and to his criticism that they were guided aright in the early days of their experimenting. He it was who first brought them to public notice by inducing them to read before the Western Society of Engineers a paper on their remarkable gliding experiments.

Chanute brought to the problem of aerodynamics what was sorely needed, namely, ripe engineering understanding. Beginning where the ill-starred Lilienthal ended, he carried the biplane glider to a point of perfection where there was little left to do but to fit it with a motor. His experiments with machines of many superposed surfaces may well be regarded as classic. The many glides that he made proved once and for all that if a multiplane machine is to be used it must be a biplane. As an engineer he saw the necessity of a rigid construction of planes and gave us the trussed biplane, which the Wrights have made familiar.

One may form some idea of the value of Chanute's work when we consider the fact that it is almost impossible to write a critical article on aviation without referring to his investigations. Lilienthal, Chanute, Langley and Maxim are the four names that will ever be inseparably linked with the early stages of flying machine development, the stages that preceded the successful invention of the first man-carrying machine by the Wright brothers. These four men elevated an inquiry which for years had been classed with such absurdities as the finding of perpetual motion and the squaring of the circle, to the dignity of a legitimate engineering pursuit. The fruits of their labors we see in the hundreds of machines that now fly in Europe and in America—the realization of an age-long dream.

ELECTRICITY.

A novel electric lamp is described in a recent British patent. It consists of a Geissler tube coated on the inside with phosphorescent sulphides. The tube is filled with rarefied gas, preferably helium. It is claimed that when a current traverses the tube it excites the phosphorescent coating, producing a white light of high efficiency.

The Russian government has hitherto found it impossible to keep in touch with Kamschatka during two-thirds of the year, owing to the severe winter storms. Now, however, by the aid of wireless telegraphy, this region may be kept in communication with the rest of the world all the year round. A series of stations has been established, and special inducements are offered to operators who will take charge of these isolated points.

Suburban electric cars are usually provided with air whistles, operated by the compressed air of the air-brake system. When the whistle has to be sounded frequently this procedure causes a serious drain on the compressed-air reservoir. To obviate this difficulty, an electrically-operated horn of a type commonly used on automobiles has recently been tested on a storage battery car operating on the Watchung branch of the Erie Railroad.

The pumps for drawing water from the lake at Chicago to dilute the sewage of the city are to be operated by electric motors. Recently, one of the triple-expansion vertical engines was replaced by a 750-horse-power motor. This motor, though but a small machine compared to the steam engine, has the same pumping capacity, namely, 40,000 cubic feet per minute. It is operated with current supplied by the hydro-electric transmission system of the Sanitary District, at a pressure of 12,000 volts, and stepped down to 2,300 volts.

The operator at the wireless telegraph station of the Mare Island navy yard recently picked up messages exchanged between Key West, Fla., and Norfolk, Va. The distance from Mare Island station to Key West is nearly 4,000 miles. Transmission wirelessly over a distance as great as this is considered quite an achievement, even over water. In the present case, however, the message was transmitted over land, and had to cross the Rocky Mountains before reaching the antenna at Mare Island. It may therefore be considered a phenomenally long wireless transmission made possible by unusually favorable conditions of the atmosphere. Transcontinental wireless telegraphy is still a thing of the distant future.

Heretofore there has been considerable bother in supplying the U. S. Navy Department with electrical apparatus, owing to the fact that each bureau had its own standard, which differed from that of the other bureaus. Recently conferences have been held with representatives of the different bureaus, and with experts from leading electrical motor manufacturers, and a definite standard has been adopted for motors and controlling apparatus that shall apply to all the bureaus of the department. It is believed that by this method a considerable economy may be effected.

An ingenious fireman at Everett, Mass., has constructed an electric fire whistle. Heretofore this town has used the steam whistles of different factories, but when these whistles failed them, it was found necessary to seek a substitute. The electric whistle which has been adopted consists of a series of diaphragms, eight in number, each vibrated by sixteen small electromagnets. The diaphragms with their coils are mounted one above the other, and all are incased in a cylinder, open at the top, from which the sound issues in great volume.

Writing in the Yale Scientific Monthly, the general superintendent of motive power of the Pennsylvania Railroad predicts that carbon lamps will be replaced by tungsten lamps for train lighting. He states that the life of the tungsten lamp has been greatly increased by the use of what is known as a "hot circuit." When the lamps are switched off, instead of breaking completely the electric current, they are switched onto a small battery current just sufficient to keep the filaments hot and barely glowing. This prevents them from becoming brittle, and hence they are not so liable to breakage under the vibration and jars incidental to railroad travel.

Attention has recently been directed to the advantage of letting an electric car coast as much as possible, and checking devices have been employed on the cars to keep track of the coasting periods, thereby determining the relative efficiency of different motormen in this direction. The operators of the cars, however, have not looked upon these devices with favor, and certain companies have found it to their advantage to treat the situation in such a way that the motorman will consider that the checking device is keeping account of his economy, rather than his wastefulness. This feeling has been prompted by giving bonuses for such men as operate their cars most economically.

AERONAUTICS

The secretary of the International Aero Federation has held up the award of the $10,000 prize to Moisant for the Statue of Liberty flight on Grahame-White's protest.

Brig.-Gen. James Allen, chief signal officer of the United States army, was taken up by Mr. Grahame-White in his Farman biplane during the Philadelphia meeting.

On November 18th Grahame-White passed over the navy yard at Philadelphia, and crossed the Delaware River into New Jersey in his Farman biplane. He came back by the same route.

The Patent Office has felt the boom in aeronautics. The applications covering various machines and methods of control come in at the rate of ninety a month, or about three a day.

A prize of $5,000 has been offered by the Havana Post for a flight of over 90 miles from Key West to the Cuban capital. The flight will be a difficult one on account of the strong wind that generally prevails along the coast of Florida above the Gulf Stream.

The Aero Club of France has decided that aeroplanes, before being offered to the public for sale, must be subjected to an official examination, so that their construction may be guaranteed. It seems to us that what is wanted more than such inspection of machines is the governmental examination of pilots.

The Kaiser's brother, Prince Henry of Prussia, has become a licensed aeroplane pilot. He succeeded in obtaining a license from the International Aeronautic Federation after three or four weeks' lessons at Darmstadt under the tutelage of August Euler, a German aviator.

John B. Moisant, who won the Statue of Liberty prize, is to tour the country at a salary of $104,000 a year. He will be one of several aviators who have been engaged by an organization to constitute what may well be termed an aerial circus. The same organization has engaged Hamilton at $72,000 a year. Among other men who will fly with the circus are Simon, Barrier, Audemars, and Frisbie.

On November 23d J. Armstrong Drexel broke the world's record for altitude at Philadelphia. In Grahame-White's 100-horse-power Blériot monoplane, he rose to a height of 9,970 feet. In all likelihood he went even higher, for the ink of his barograph gave out at 9,970 feet. Drexel was in the air an hour and twenty minutes. So rapid was his descent, that he was made ill.

Secretary of War Dickinson has recently returned from a four months' tour of the world. While in France he visited the Camp de Chalons and made three aeroplane flights with noted aviators, the longest being over a half hour's duration. Having had a complete demonstration of what has been accomplished abroad in military aeronautics, he is quite aware of the backwardness of the United States, and he expects to recommend at once the purchase of at least ten aeroplanes for our army. He believes that every army post should have one or more machines.

A balloon flight from the Pacific coast to the Atlantic coast may possibly be attempted next year. P. Chester Thompson of New York has promised $10,000 to finance the trip, and will give in addition a trophy of $1,000. The offer was made to Charles J. Glidden, and by him accepted. H. H. Clayton, who was aid in the balloon "Pommern," which won the International Balloon Race in 1908, will be the pilot for the coast to coast trip. Mr. Thompson makes no conditions as to the trip other than that the start shall be made at some place on the Pacific coast, and landing not less than fifty miles from the Atlantic coast.

There is at present under construction at the naval construction works of Messrs. Vickers, Sons & Maxim, Barrow-in-Furness, England, a mammoth dirigible designed for the exclusive purpose of co-operating with the navy. The utmost reticence is kept by the authorities with regard to details, but it has transpired that, when completed, it will be the largest armed dirigible in the world, larger than any of the Zeppelin type. It has a carrying capacity for a crew of thirty-four, but only six officers and men will at present be required. The engines are of 200 horse-power, and the airship is designed to make long voyages in all conditions of the weather. The gas bags are covered with a metallic coating, which makes it both rigid and protective. It will be equipped with special aerial weapons, the exact nature of which is not yet known. Special crews are now undergoing training in aeronautics under the commander of naval airship "No. 1," Lieut. Neville F. Osborne, R.N., one of the torpedo experts of the British Navy. The second-class cruiser "Hermaine" has been selected for special duty to Britain's latest acquisition.

SCIENCE.

A department of public health has been created by the American Museum of Natural History for the benefit of the community's health. There is at present no comprehensive collection of bacteria in the United States. A laboratory will be installed, and will keep under cultivation a complete collection of bacteria. Public exhibits will be held, which will deal chiefly with certain phases of municipal sanitation. The curator in charge of the new department will be Prof. Charles Edward Amory Winslow.

The Royal Prussian Aeronautical Observatory at Lindenberg is considering the establishment of a forecasting and storm-warning service for aeronauts, on a larger scale than has ever before been attempted. It is proposed to add the observation of the upper air currents, by means of pilot balloons, to the regular routine of the stations of the Public Weather Service, and to centralize the reports of these observations at Lindenberg. The publication of an afternoon weather map is a part of the programme.

The Chilean government is planning to erect a meteorological observatory near San Bernardo, a short distance south of Santiago, as a part of the elaborate reorganization of the national meteorological service, recently undertaken. The German director of the service, Dr. Walter Knoche, is now engaged in establishing stations throughout the country, and equipping them with French and German instruments of the latest type. The central office is at Santiago. An office to handle the marine work of the service will be established at Valparaiso. Terrestrial magnetism and aerological observations are to be included ultimately in the programme of the new service.

The forecasters of the British Meteorological Office have always felt keenly the need of more telegraphic observations from the regions to the westward of the British Isles. Wireless reports from steamships have not proven so valuable as had been hoped, but they are still regularly received, and with improved methods of transmission may ultimately become a most important auxiliary to the land observations. A recent notable extension of the meteorological *réseau* to the westward was, however, effected through the establishment of a regular telegraphic station at Funchal, Madeira, and it is hoped that similar stations may finally be secured in the Canaries and the Cape Verde Islands. Weather reports from the Azores have been received daily by telegraph for some years.

It is usual, before the ascent of a manned balloon, to send up one or more pilot balloons, i. e., small free balloons with no basket attached, the course of which is followed with a theodolite, or otherwise, in order to determine the force and the direction of the air currents likely to be encountered by the aeronaut. In order to make this process possible by night as well as by day, a luminous pilot balloon has been introduced by S. Paul, of Aix-la-Chapelle. An electric lamp is installed inside the balloon, being fed by a small battery suspended beneath. The transparent envelope is red, an arrangement that makes it easy to distinguish the balloon from the stars, when it reaches a great altitude. To facilitate the recovery of the balloon, an automatic valve is provided, which opens at a predetermined altitude and allows the apparatus to fall to the ground.

When we speak of a metal being in a crystalline state, we almost invariably associate that state with the idea of hardness. Even practical metallurgists entertain this notion, although, as a high authority has pointed out, in the pure ductile metals the crystalline state is actually the soft state. A large part of this softness is ascribed to the instability of the crystalline structure. When a metal is drawn into wire, its tenacity is enormously increased; that of iron four times, that of pure gold more than three times, and that of silver and copper still more. But investigation shows that metals that have been thus treated show a micro-structure in which deformed and broken-down crystals are imbedded in a non-crystalline mass. In the process of hardening a metal, its crystalline structure is broken down, and it passes into the non-crystalline form.

The second and concluding volume of "Das Klima der Schweiz," by J. Maurer, R. Billwiller, Jr., and C. Hess, containing the tabulated statistics of the climate of Switzerland, has just appeared. The first volume, containing the descriptive text, was published last year. Switzerland accordingly now takes its place among the countries whose climatography is represented in a single comprehensive work. In general, climatographic literature is scattered high and low through a vast number of books, many of them difficult of access, and it is therefore extremely gratifying to note the appearance of a work that saves one the trouble of exploring a whole library of memoirs, scientific journals, officials reports, etc., in order to unearth the existing information as to the climate of a particular country.

THE AWARD OF THE SCIENTIFIC AMERICAN MEDAL

AN ANNUAL MEDAL FOR THE BEST DEVICE FOR CONSERVING HUMAN LIFE AND LIMB

For the second time the Scientific American medal for presentation to such American individual or corporation as has produced and exhibited in the American Museum of Safety within a recent period of years, the best perfected and practical device for conserving human life and limb in the processes of productive industry, was awarded on November 21st, at the formal opening of the permanent Exposition of Safety at the Museum in the Engineering Societies' Building in New York city. A distinguished audience thronged the auditorium after visiting the museum on the sixth floor in the Engineering Society's building.

Mr. Philip T. Dodge, president, called the meeting to order. Greetings from the President of the United States and from Associate Justice Charles E. Hughes were read. Among the speakers were Mr. Edson S. Lott, Dr. Norman E. Ditman, Dr. W. H. Tolman, the director; Mr. T. Commerford Martin, and Mr. S. C. Dunham, who presented the Travelers' Insurance Company's medal to the United States Steel Corporation for their remarkable care in safeguarding their vast industrial army.

The presentation of the Scientific American gold medal followed the address, being made by Prof. F. R. Hutton, who announced that the medal was awarded to the Patent Scaffolding Company of New York for the design and construction of masons' suspended platforms. The medal was accepted by Mr. Alfred E. Davidson, president of the company.

The high building has brought its own problems, which are only now being solved in many instances. The erection of each of the modern skyscrapers has taken its toll in human lives, while masons and bricklayers were working on wooden scaffolds supported by horses and cantilevers. Abroad, particularly in France and Germany, a building being erected is surrounded by a forest of timbers supporting the scaffolding. In this country time is everything, and builders will not also go to the expense of such rather useless constructions, hence the dangerous if economical plan noted above. In five years in New York alone there were 660 deaths caused by falls from new buildings, while 177 deaths were caused by falls from scaffolds alone. Since the introduction of the new form of scaffold, there have been no fatal accidents where it is in use. In the last two years 319 buildings were erected with its aid, and 8,265 machines were employed, and the men were all unharmed.

The construction will readily be understood by reference to the engraving. The scaffold is interrupted so as to make sections ten feet long. At the ends of each section of planking are a pair of winches secured to a horizontal iron beam serving to support the planks. The winches are composed of a drum around which wire rope is roved, and the necessary supporting members. The upper end of the wire rope is secured to an outrigger by an anchor bolt, thus serving to support the scaffold. To the drums are secured ratchet wheels. A lever serves to actuate a pawl, which raises or lowers the scaffold by means of the ratchets which serve to turn the drum which winds up the cables. As the sections are small, one man can raise his section very quickly by a few strokes of the four levers at each corner. The speed is very considerable, and permits workmen to operate in sections, which is often important when material does not arrive, or where there are many openings. One of our engravings shows a building with part of the brickwork in place and a scaffold warped up at an angle. The great danger in scaffolding is in the use of imperfect and worn-out material, and for this reason with the present device inspections are constant, and all worn parts are replaced at the end of each job. We are indebted to Mr. R. T. Bacher for technical information in the preparation of this article.

Something About Pipe Covering.

Nowadays, when there are so many factories equipped with steam boilers, in order to operate their

Scientific American medal for devices conserving human life and limb.

machinery by steam power, to boil their products by steam, to heat their premises with it, or which circulate hot or cold water throughout the entire establishment, there are still concerns to be found which have protected neither their boilers nor their steam or water conductors, by means of heat-insulating material. It often happens, for instance after the holidays or other prolonged period of idleness, that the conductors, during the severe frosts of winter, will be completely frozen up, so that the ice inside them must be melted with the aid of hot coals, before work can be resumed. This neglect entails, moreover, other damage, for instance, loss of heat with an increased consumption of fuel, the amount of which, in such a factory, will reach a respectable sum annually. The radiated heat from the steam boiler or the steam pipes, is quite bearable in winter, but in summer, it is less pleasant or desirable, not only exercising a bad effect in some departments, but causing the workpeople to become prematurely fatigued. On paying a visit, for instance, to a factory, perhaps quite modern in arrangement and equipped with the latest technical improvements, in which the portions of the boiler not built in and the steam and water pipes are not covered, it is liable, at first sight, to create an unfavorable impression, with the visitor; it suggests slovenliness or that the factory proprietor begrudged useful expenditures.

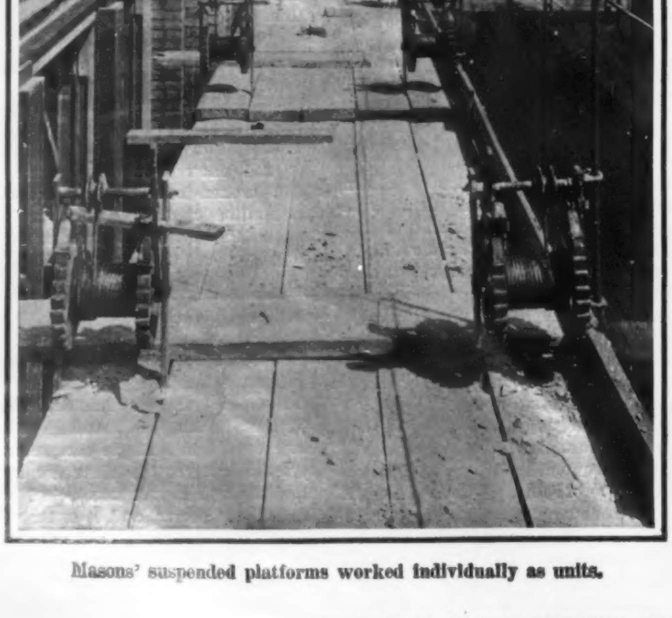
We shall proceed to show how the covering can be accomplished, with small outlay and inconsiderable expenditure of labor, at a time, when perhaps the factory is not so busy, and by its own working force.

The covering for heat insulation, can be carried out with widely varying material. As heat-protective substances we have principally Kieselguhr (infusorial earth or fossil meal), cork or wood dust, straw or spun glass, also loam, clay, and the like, formed with the admixture of a fibrous substance, like asbestos fiber, tow, cow-hair as a binder, into slabs, pipe segments, etc., or woven into rope, braid, or mats and fastened or directly applied to them.

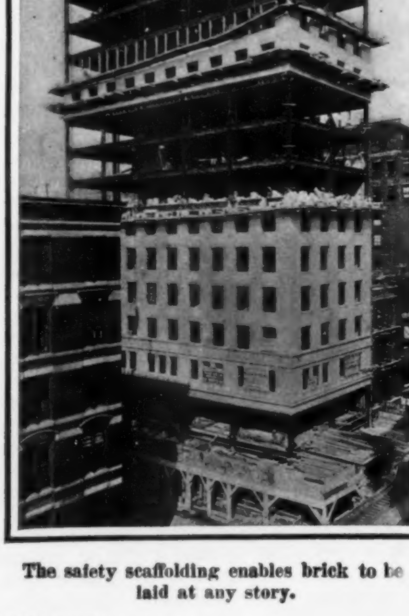
The requirements of a good, practical heat-insulating substance are about as follows: It must consist of a substance that is a bad conductor of heat, must be as light, cheap, and durable as possible, must not chip off or crack nor resolve itself into powder when perfectly dry. The first conditions may be met by the material itself, the last-mentioned a proper binding substance will insure. Kieselguhr, with or without granulated cork, is an effective heat-insulating material, combined with loam or clay and mixed as a binder with molasses, suitably diluted with water, water-glass, or a small quantity of flour in water, or a weak solution of glue. To promote the holding together of the mass, even in a dry condition, we incorporate with it, where it is to be used on a hot surface, preferably asbestos fibers, for colder or cold objects cow hair, tow, mineral wool, or other fibrous residues of spinning processes.

For heat insulation, as a rule, one mass will usually suffice, but use is nevertheless to be recommended of two masses, differing in composition, one of which serves as a foundation mass and is applied directly to the object, or in other words on the metal; it must adhere firmly to the metal and be more heat-resistant than the second substance, which is applied over the ground-mass. For the latter, which comes into direct contact with the object to be insulated, and in consequence dries more rapidly, but is also exposed to the risk of cracking or peeling off, molasses and water-glass for the binder and asbestos fiber are in order, while the second insulating substance may consist only of a thin glue solution, or of flour, made into a paste with boiling water, and cow hair or other cheap refuse of animal or vegetable

(Continued on page 447.)



Masons' suspended platforms worked individually as units.



The safety scaffolding enables brick to be laid at any story.

THE AWARD OF THE SCIENTIFIC AMERICAN MEDAL.

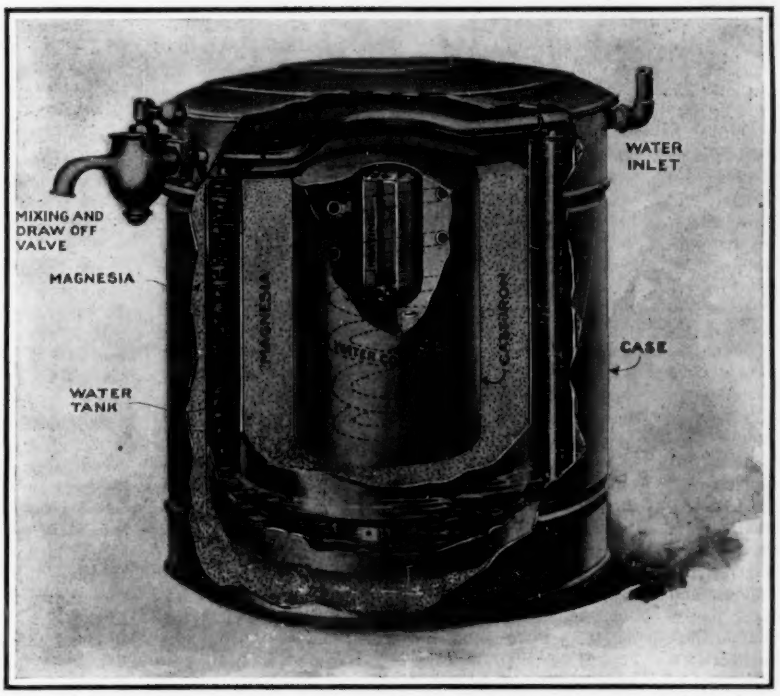
ELECTRIC HOT-WATER SUPPLY SYSTEM

BY JOSEPH B. BAKER

The utilization of household electric heating devices has greatly increased in the past few years, thanks to the convenience and safety of these apparatus and the interesting novelty of their employment. The one great drawback has been the cost of electricity to run them, and this limitation has directed electric heating into the channel of utilization in a great variety of current-consuming devices—small cooking utensils and heaters for special purposes—and has prevented its utilization in appliances developing large amounts of heat. A new appliance which promises much in popularizing the consumption of electricity for supplying hot water in considerable quantities utilizes the heat-storage capacity of a mass of metal to deliver hot water of any desired temperature at any time when it is needed, whether or not the electric current is turned on at the time.

This electric heat-storage system marks an important step in the distribution of heat by the medium of the ordinary electricity supply mains. And in this respect it repeats the history of gas light and electric light distribution. Time was when every household made its own candles. Then came oil lamps, burning oils of animal and vegetable origin, and later, kerosene lamps requiring a chimney. The introduction of gas was the first step in the distribution of light and heat for the whole community from a central generating station; and with the development of the internal-combustion engine, gas also became available for power purposes. But hitherto electricity, the great rival of gas as an agent for the distribution of light and of power, has been at a disadvantage for use in the local production of heat, for two reasons, viz., transformation losses between central-station coal pile and heat generated in the consumer's translating device, and poor central-station load factor due to the natural irregularity in demand for current for lighting.

To discuss the first-mentioned reason: It is true that the efficiency of conversion of electricity into heat is one hundred per cent; but this energy transformation, made on the consumer's premises, is only the last one of a series of transformations. The aggregate of the heavy losses back of the delivery of the electric current to the consumer—that is, in the chain of transformations from the heat energy represented by the coal pile into electrical energy at the central station switchboard—has made electrically generated heat prohibitively expensive when large amounts of heat were required, in the household and under all customary industrial conditions.



AN ELECTRIC HEAT STORAGE SYSTEM FOR SUPPLYING ELECTRICALLY HEATED WATER IN CONSIDERABLE QUANTITIES.

As to the second reason: Even with the existing transformation losses, electric current for all purposes would cost the consumer much less than it does at present were it not that although the electric light is the main load in every central station, the output from the station for lighting is very irregular through the twenty-four hours of each day. The demand for light reaches a maximum, or "peak," at a certain hour every day—later or earlier according to the advance of the season—and a large amount of central-station machinery, capable of delivering the electricity for this peak load, must be installed, although this load only lasts a short time. During the remainder of the twenty-four hours the greater part of the machinery is idle, though continuing to draw interest on the heavy investment of capital which it represents.

To summarize: The private consumer pays at a high rate for his kilowatt-hours of electricity, on account of inefficient generation of power, and uneconomical utilization of the central-station plant necessitated by the irregular demand for light; and this existing high rate has delayed the general introduction of electrical appliances.

The transformation losses mentioned can not be reduced mate-

(Continued on page 448.)

MOTOR-DRIVEN PLOW AND CULTIVATOR

BY H. E. MILLER

For centuries men have cultivated the soil by means of simple plows pulled by animal force. Although these instruments have been improved as much as possible to the extent of accomplishing the work they were designed for, they proved not to be effective enough, for the cultivation of vast territories in the proper length of time and with the comparatively small number of hands available.

For this reason, the Fowler system, consisting of two locomobiles, pulling a set of plows back and forth between them, was put into operation, which, in its time, was a great improvement, being the first big and successful step toward mechanical plowing. Unfortunately, the price and the cost of running of such machines are only in the reach of the owners of very large estates.

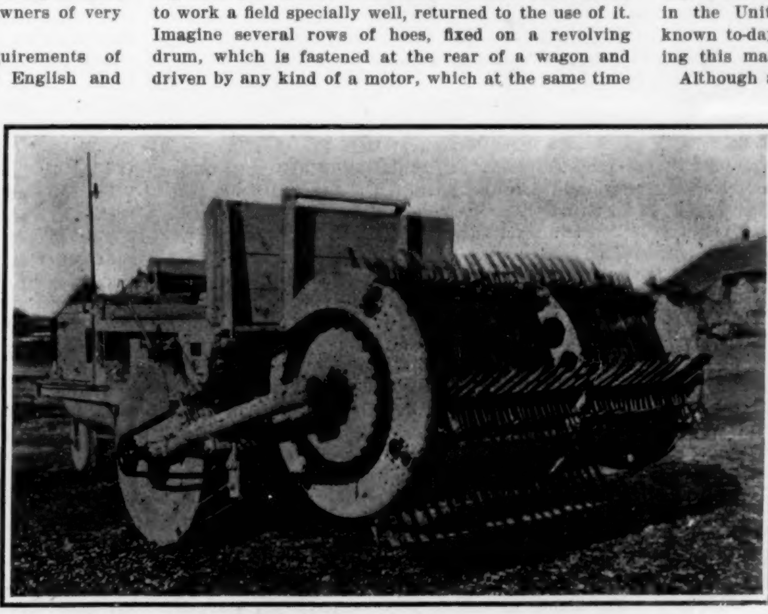
Traction engines, meeting the requirements of smaller farmers, were brought out by English and American manufacturers. They allowed the use of two, three, or more furrow plows, attached to them and working under the direction of one or two men only.

In spite of all the remarkable service done by such machines under favorable conditions, one must concede that they are utterly ineffective, in hard ground, because of the engine not having traction effort enough to pull the plows in spite of all the weight put on them, while in soft ground this same weight causes the machines to stick hopelessly in the field.

This is the reason why even nowadays the use of motor-driven implements for plowing is by no means a general one, as it could be made, and why a machine, avoiding the above-mentioned fundamental disadvantages, would meet a very great success. So far the only machine fulfilling all the requirements of a motor-driven cultivator is the Universal agricultural motor car, put on the market by the St. George's Machine Works at Zurich, Switzerland. This machine was brought out after two years continual experimenting and laboring, and received the unanimous approbation and admiration of Swiss and foreign farmers, who met to witness a demonstration, given before the Swiss Agricultural Society in April last at Zurich. The secret of its success lies in the fact that in this machine the problem of mechanical laboring is met on the principle of replacing the plow by the hoe. Men had used this tool (the hoe) long before they learned to employ animal force for pulling their plows, and at all times farmers who wanted to work a field specially well, returned to the use of it. Imagine several rows of hoes, fixed on a revolving drum, which is fastened at the rear of a wagon and driven by any kind of a motor, which at the same time propels the vehicle. Such a combination permits to hoe a strip of great breadth to any depth desired, with the minimum of energy necessary, because the car, instead of meeting resistance to its movement, works itself forward by the action of the drum and hoes. For this reason the car itself can be made very light and requires a comparatively small motor, whereas it leaves the field thoroughly worked to any depth required, ready for sowing. This machine is worked by one man.

Each machine is supplied with a number of sets of tools, varying according to their application; and it may be specially mentioned that dry farming, according to the method originated by Mr. Samuel Campbell in the United States, which is almost universally known to-day, can be admirably performed by employing this machine.

Although any kind of motor could be used for agricultural purposes, internal-combustion motors or electric motors are practically the only ones considered for this purpose. The future also in this line will be in the crude oil motor, the application of which for traction purposes is now a certainty, since the St. George's Machine Works has put on the market small high-speed Diesel motors of 5 horse-power output at 750 revolutions per minute. The actual type of car is fitted with a 35 horse-power gasoline motor of 800 revolutions per minute, whose power is transmitted through a cone clutch to the gear box, similar to the arrangement in a normal automobile truck. From this gear box three independent shafts transmit the power, one by means of the differential gear and a double-chain drive to the back wheels, allowing speeds of ½, 1, 2, and 4



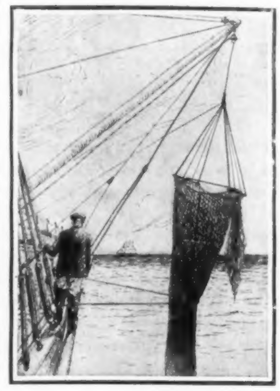
A SWISS MOTOR-DRIVEN PLOW AND CULTIVATOR.

(Continued on page 448.)

THE LIFE OF THE DEEP SEA

THE MODERN SCIENCE OF MARINE BIOLOGY

BY HERBERT T. WADE



Sir John Murray, the distinguished oceanographer who recently visited the United States, remarked in an address made a few years ago before the British Association for the Advancement of Science, that "The deep sea discoveries of the past quarter of a century have been the most important additions to the natural knowledge of this planet since the great voyages of Columbus and Magellan." To-day more than ever interest is being manifested in deep-sea biology. The methods and apparatus used in the study of the oceans and their living forms are as replete with interest as the results obtained are valuable to science.

The sea supports animal life as varied as the land, and the conditions under which it exists are even more diversified. In fact it is usual to divide the animal life of the deep sea into three great categories. The first of these, the Plankton, consists of organisms, for the most part minute, to be found nearly everywhere floating in great abundance on the surface of the open ocean. Next come the Pelagic forms which live near the surface, but choose the open sea in preference to shore waters, moving about either in schools as in the case of the smaller fishes, or singly as do the whales and sharks. Finally there is the bassalian fauna, the life of the depths known as the Benthos, which embraces the animals living below a depth of 500 feet or about 85 fathoms, and includes forms varying from fishes, swimming freely, to sea-urchins, shrimps, crabs, crinoids and a great number of microscopic organisms. The area inhabited by the bassalian fauna lies for the most part below the point where sunlight penetrates, and is of cold and constant temperature. Here the pressures are great, and at a depth of water of one mile there is experienced a pressure of 2,312 pounds to the square inch as compared with the 15 pounds to the square inch at the earth's surface due to an atmosphere rising to a height of about 40 miles. In the deep sea this pressure increases proportionately with the increase of depth or roughly by a ton per square inch for every mile or thousand fathoms of depth.

FAMOUS EXPEDITIONS.

Oceanography, or the science that deals with the study of the ocean, its currents, winds, bed, water, and inhabitants, bears a most obvious relation to navigation, and the early collection of data relating to depths and currents was undertaken rather for practical ends than for theoretical investigation. By referring the depth obtained by the sounding lead and line to the bathymetrical chart, and the sample of the bottom brought up in the arming, or tallow in a recess at the lower end of the lead, to a lithological chart on which the nature of the bottom at different points is indicated, the navigator is enabled to ascertain his position, especially on certain well traversed sea routes where these conditions have been carefully observed and recorded. In most cases early hydrographic work and deep-sea exploration were undertaken by naval officers of scientific tastes who became interested in the biological questions arising in such exploration, both in so far as they concerned fisheries and as mere scientific problems. Thus, in 1818, John Ross while sounding in Baffins Bay found an *Asteria* at a depth of 984 fathoms, and from this time there was a growing interest in the forms of life that might be found at or near the bottom of the ocean. In 1846 the United States Coast Survey undertook an investigation of the Gulf Stream, and in 1860 while making soundings for the Atlantic cable between Ireland and Newfoundland *Asteria* and *Serpula* were brought up from depths of 670 and 1,240 fathoms. On a scientific expedition Pourtales in the United States Coast Survey steamship Corwin" dredged down to a depth of 600 fathoms, and then the British steamships "Lightning" and "Porcupine" made what have been termed trial trips in deep-sea exploration. As a result of these opportunities to study the bottom of the ocean, interest in biological problems in this new field was stimulated, and when the British ship "Challenger" started on its memorable three years' cruise in 1872, deep-sea biology was placed on a firm foundation. The work of the "Challenger" was largely in the Pacific, but in the Atlantic along the eastern coast of North America the United States Coast Survey vessel "Blake," under the scientific direction of the late Prof. Alexander Agassiz, made several important cruises. The success of the "Blake" led to the construction of the "Albatross" in 1883, and this vessel, shown on our frontispiece, is still in service and entitled to first place on the honor roll of deep-sea exploration, in addition to its other work for the United States Fish Commission. Supplied with special machinery for sounding and dredging as well as with laboratories for the scientific staff, it soon became a veritable and complete oceanographical laboratory itself. Its deep-sea work was under the direction of Prof. Agassiz, who until his recent lamented death was the recognized leader in this field of scientific endeavor. After service on the Atlantic coast the "Albatross" was transferred to the Pacific, where many discoveries were made on cruises that included vast areas hitherto unexplored. On the Atlantic since about 1881 the United States Fish Commission steamer "Fish Hawk," when not engaged in fish hatching, has been used for dredging and other deep-sea biological work. Sharing the honors with the "Challenger" and "Albatross" have been the various vessels of the Prince of Monaco, who to-day is one of the most active students and patrons of oceanography. From 1885, when he commenced his scientific exploration in his ocean-going yacht "Hirondelle" to the present day, when aboard his "Princess Alice" well equipped and specially designed for deep-sea exploration, he has been engaged a great part of each year on scientific expeditions. Nor is his interest in oceanography confined to the sea; for the recently completed oceanographical museum at Monaco forms an imposing and useful monument to the scientific activity of the Prince and affords not only a home for his collections, but laboratories for investigators. Another ship more recent is the Norwegian vessel "Michael Sars," put in commission within a year, and now under charter to Sir John Murray, the famous Scotch oceanographer and veteran of the "Challenger" expedition, the compilation of whose valuable records he brought to a successful close. The "Albatross" and the "Princess Alice" stand out as the only vessels engaged in such exploration which have been maintained in constant commission over extended periods of time.

DEEP-SEA APPARATUS.

First and most important of the various devices for sounding and collecting is the sounding machine by which a lead or weight at the end of a fine steel piano wire is dropped to the bottom, together with a registering thermometer and a cylinder or other arrangement which opens to inclose a sample of the ooze or mud at the sea floor. On this line may also be sent down various cups which fill with sea water at any desired depth and then close tightly. This wire is paid out from a reel placed on a platform in the bows and, as it is unwound, the distance or depth is read off from indicators. For the lesser depths lighter weights or ship's leads are employed and the specimen from the bottom is secured from the arming. Next to the depth and the character of the bottom the temperature is the most important item, and self-registering thermometers housed in a metallic frame or cover and of sufficient strength to resist deep-sea pressures are employed. It is estimated that 92 per cent of the entire sea floor has a temperature less than 40 deg. F. as contrasted with the surface of the sea where only 16 per cent is at a mean temperature lower than 40 deg. F. The self-closing water cups afford material for the determination of the density and salinity and for chemical analysis. With increased depth the difficulties in sounding as in all deep-sea work increase, but depths up to 5,269 fathoms, or nearly six miles, have been recorded, this being the record made by the United States cable ship "Nero" in the Western Pacific, using the "Albatross" apparatus. To make a sounding to a depth of three miles and to get the instruments back on board the ship requires about an hour and the use of a special steam engine in connection with the reeling mechanism.

For biological studies such physical data are even more essential than for navigation, as they show the environment of the life of the seas. For the collection of living specimens nets are towed through the sea or dredges or trawls are dragged over the bottom. At the surface there can be employed hand nets or surface tow-nets of any convenient form rigged from the end of a suspended spar or boom. Often this is done when the ship is engaged in deep-sea dredging, but on the opposite side of the vessel from the trawl. The surface tow-net captures the minute crustaceans, pellagic molluscs, and other small fry, and is arranged with pockets to prevent the escape of the specimens. When the marine naturalist wishes to obtain representatives of the animal forms at intermediate depths he may use a gravitation trap, which consists of a metal cylinder covered with gauze at the upper end and having a flat valve at the lower end. This valve can be kept open during a rapid vertical descent of the cylinder between any two depths as may be desired, and the specimens captured and retained. Somewhat more practical than the gravitation cylinder is some form of closing tow-net which can be used at depths from 20 to 200 fathoms and consists of a series of nets one within the other attached to a folding brass ring. This net, after being lowered to a desired depth, is towed through the water until it is desired to heave in, when the jars are closed by means of a messenger or weight sent down along the tow line to a tripping device, which closes the jaws as shown in the front page illustration.

Most of the fish living at the surface of the water in the deep sea as distinguished from those inhabiting shore waters on the continental slopes, where the distribution of animal life is often continuous, are restricted in their habitation and the intermediate nets usually obtain but little of consequence save near the surface and at the bottom. When the sea floor, with a more extensive fauna, is reached, there are a number of devices available. Such are the tangles, which are dragged along a rocky bottom to capture specimens. They consist of deck swabs or bundles of rope yarn attached to an iron bar bent in the form of a V. For such forms as mollusca, annelids, crustacea, etc., which burrow beneath the surface out of reach of ordinary apparatus, there is employed the rake dredge, which is a frame with teeth about seven inches in length, followed by a dredge proper into the net of which the specimens are gathered. With a dredge or trawl may be used a mud bag to collect a compact mass of the bottom mud or ooze, which not only affords a sample greater in amount than that supplied by the cylinder with the sounding weight, but often contains numerous specimens. For dredging along the sea bottom, which has been done down as deep as four and one-half miles, the deep-sea beam trawl is used, which consists of a net arrangement rigged to an iron frame across the mouth of which there extends an iron beam which may be dragged along the bottom to sweep the specimens into the net. Ordinarily the trawl is about 11 feet wide by 2 feet high, with a net 20 feet in length, being towed by a wire rope rigged through a boom carried on the starboard side. A dredge haul from a depth of four and one-half miles is quite an undertaking and requires 10 hours.

In the course of the journey to the surface most of the ooze is washed away, but with good fortune the specimens are retained. These of course vary with the locality and the depth, and it must be remembered that those from the greatest depths live under truly extraordinary conditions, and a deep-sea animal expires on its upward trip long before it reaches the surface. If from a sufficient depth where the pressure is great its appearance suggests an internal explosion due to the sudden relief of pressure, and the eyes seem to be blown out of their sockets and the bodies greatly swelled. Many of the animals from the depths are cartilaginous and do not have a bony structure, as the very cold water at the bottom, only a few degrees removed from a freezing temperature, is not conducive to the formation of carbonate of lime.

In addition to the cold there is also the absence of sunlight, and recent observations by Sir John Murray show that from 300 fathoms downward the effect of light gradually decreases to zero at about 900

fathoms, the violet rays penetrating deeper than other parts of the spectrum. Down in the depths phosphorescence plays an important part, and many animals have organs or processes for generating light which may be used where otherwise sight would be useless. Again in other cases the organs of sight have degenerated or disappeared entirely. It is the opinion of most deep-sea explorers, and confirmed by the cruises of the "Albatross" in 1899, and of Sir John Murray in the "Michael Sars" in the present year, that at great depths at considerable distance from land and away from any great oceanic current there is comparatively little animal life to be found, though specimens were obtained by the "Albatross" from 4,173 fathoms.

The Prince of Monaco argued that the deep-sea animals might be too cunning to be eaught in a clumsy trawl, and accordingly designed a trap which could be used on the bottom surface, and with it he has caught an amphiopod at as great a depth as 3,000 fathoms, and often at 700 fathoms. Increasing the size of the dredge has also brought to light larger fish, and while dredging from the "Albatross" off the coast of Chile, Gill and Townsend secured at a depth of 1,000 fathoms a very heavy fish five feet in length, entirely unknown to naturalists.

The animals of the deep sea occasionally present archaic characteristics, but taken as a whole among them are not represented any more remnants of the faunas of remote geological periods than are to be found in the shallow and fresh waters of the continents. This can be readily understood, as the deep sea is believed to be the last place on the earth's surface to be inhabited, and the comparison of deep-sea animal forms with those known to the paleontologist in fossil remains seems to bear out this theory.

On the sea bottoms are found fish and members of the invertebrate groups quite unlike those of the shores, while the very ooze of the bottom itself often is formed by the decomposition of dead organisms from a higher level falling with their shells. On the illustration have been noted some of the curious fish with the depths of their habitation, and while they can be considered as typical, yet it must be remembered that the variety of life is almost infinite and that the microscopic organisms concern the zoologist quite as much as those of more appreciable size. Sir John Murray believes that there is animal life through all the layers of sea from the surface to the bottom, and that there is not, as has been believed, a stratum where life is absent, located below those layers of the sea where the pelagic forms are most numerous.

When attention is called to the fact that great reefs and islands have been formed through the activity of small coral animals we have but a single instance of the importance of zoological studies in the deep seas, and other results already attained in the biological branches of oceanography are of no less importance. To-day hundreds of naturalists are working on the materials and data collected by Agassiz, the Prince of Monaco, and other deep-sea explorers, and each year science is enriched with further knowledge of the interesting planet on which we live as the depths of the sea are beginning to yield up their secrets long hidden from man.

Joseph Brucker on Wellman.

Our German contemporary Umschau publishes an article by Joseph Brucker on Wellman's attempted aerial voyage across the Atlantic. Mr. Brucker's remarks are of interest, because it is his intention to attempt a similar feat in the opposite direction from the Cape Verde Islands to the West Indies. He says:

"I have repeatedly pointed out that in the present state of the art, it will be impossible to cross the Atlantic Ocean with an airship north of the thirty-fifth parallel of latitude, because in that region one depression follows another, and above all at this period (October) of the year. Wellman was meteorologically ill advised. By that I do not mean that the weather reports which he received from Washington were not trustworthy, but that a serious study of the meteorological conditions must have dissuaded him from setting out on such an expedition.

"On Saturday, the 15th of October, it was well known that a violent hurricane was raging in Cuba. It is well known also that such violent disturbances of the atmosphere in those latitudes are followed by extraordinary collateral phenomena in latitudes thirty-five to forty degrees north. Whoever would take the trouble to follow the journey of the 'America' as charted by Wellman, will find this statement confirmed. The 'America' at first flew in a northeasterly direction until it was about south of Cape Sable. It was then suddenly driven in a southeasterly direction by a northwest storm and then again to the southwest to a spot where it crossed the direct line between New York and Bermuda almost in the same latitude as Cape Hatteras.

"It also seems that Wellman could not rely on his motors. One of his engines was disabled soon after he set out and the other was probably not powerful enough to enable the 'America,' when the northwest winds blew up, to keep a more easterly course. The 'America' seems to have traveled more like a free balloon, for which reason this performance should not be regarded as a record for dirigible airships. Wellman would probably hardly maintain that he could follow a definite course with his 'airship.'

"Another fatal error was the 'equilibrator,' to which Engineer Vaniman pinned his fate. This 'equilibrator' was in itself a very cumbrous contrivance with its thirty gasoline tanks, and turned out to be a source of danger to the 'America.'

"Dr. Alt of the Munich Meteorological Station and I have made many experiments during the last few months with arrangements similar to Wellman's equilibrator. We have given the tanks the most diverse forms, only to come to the conclusion that all such devices, when an airship is traveling over water, not only produce an enormous resistance, but are also highly dangerous to the airship itself. The 'America' seems to have perished from appendicitis. A surgical operation, however, could not be performed, because the airship, if it had been relieved of its burden, would have risen to an enormous height, and would have faced new dangers.

"The expedition which I have organized is the result of scientific study. It is our intention to start from the Cape Verde Islands, about 2,350 miles from the Lesser Antilles. There are no counter winds in our course, no storms, no fogs, but we hope to travel with the wind at a rate of about seven meters per second.

"In the beginning of December we hope to attach the boat to the gas envelope, the capacity of which has been increased recently to nine thousand cubic meters. After that the airship will be christened 'Suchard' of the Parseval shed at Munich. By the end of January we will ship the entire apparatus to the Island of St. Vincent in the Cape Verde group. The latter part of February or the beginning of March, we hope to start our journey."

Motion of Molecules in the Tail of Halley's Comet.

Prof. Lowell has issued a bulletin on the motion of molecules in the tail of Halley's comet. In this bulletin he has endeavored to measure the recession of the tail particles, so as to obtain both an observational proof of the recession, and also something approaching an exact value of the velocity at a given time and place. He used some 200 photographs, more or less, of the comet, taken at his observatory between April 18th and June 6th. From this he selected a pair taken one after the other on the same evening, that of May 23rd, in which it was possible to detect irregularities capable of recognition and measurement. Choosing four of the more salient features, he measured their distance from the nucleus on the two plates. He found that the distance was greater on the second plate than on the first, and furthermore that the differential distances increased with distance from the heat. The first plate was exposed from 9 hours 23 minutes to 9 hours 53 minutes and the second from 10 hours to 10 hours 53 minutes.

When the angular amounts of the changes in place of the several knots were corrected for differential refraction and then reduced to speeds, account being taken of the distance of the comet from the earth and of the inclination to the line of sight of the respective positions along the tail, the results came out as follows:

TAIL OF HALLEY'S COMET.

	Angular distance from the nucleus to the point measured in the tail.		Velocity of the point of the tail away from the nucleus.
	Deg.	Min.	Miles a Second.
Knot 1	1	28	13.6
Knot 2	3	12	17.2
Knot 3	4	36	19.7
Knot 4	6	15	29.7

The Current Supplement.

Mary Cynthia Dickerson's excellent description of the American Museum of Natural History's expedition in the heart of Africa is concluded in the current Supplement, No. 1822.—Gen. J. P. Farley, U. S. A., retired, traces the evolution of the silencer for military rifles.—Cornelius D. Ehret's review of wireless telegraphy and telephony is concluded.—P. F. Mottelay writes sympathetically on André Marie Ampère.—The old geometrical problem that the square on the hypothenuse is equal to the sum of the squares on the other two sides is considered by Mr. Arthur R. Colburn. He presents many solutions different from those with which we are familiar.—Dr. Adolf Koelsch contributes an article on color sensitiveness in animals.—A description of the airship in which E. T. Willows recently crossed the English Channel is published.—Mr. J. Mayne Baltimore writes on the great bridge which spans the Copper River.—The concluding installment of Mr. Grover Cleveland Loening's paper on "The Practice and Theory of Aviation" is published.

Goiters and Cretinism.

We are often reminded that all science is one, and that we have sciences for convenience in investigating and classifying. We are also made to marvel at the remarkable interrelations that exist among different fields of knowledge; we come to expect the sciences to co-operate and are not startled when a discovery in astronomy advances the solution of a problem in chemistry, or when an accident in an electrical laboratory clears up a physiological mystery. But we have not yet learned to look to geology for help in medicine. But all science is one.

In certain parts of Switzerland goiters and imbeciles are as abundant as grafters in Pennsylvania or millionaires in Pittsburg.

The cause of the goiter is a swelling of the thyroid gland, which lies in the front part of the neck. The cause of cretinism is a failure of this same thyroid gland to produce the proper juice. But what makes the gland swell up, or go back on its normal juice-making function, has not been ascertained.

It has been known that these abnormalities are associated with the drinking of certain waters. In regions where these diseases are common an improvement always followed the introduction of a new water supply. That the water is responsible is further shown experimentally: rabbits and other animals, and even fishes, have developed goiters as a result of being supplied with water from "goiter-wells."

These facts led to the suspicion of "germs." This suspicion was strengthened by the fact that boiling the water makes it harmless. But attempts to isolate the supposed microbes all ended in failure. Not only was there no success in cultivating malignant germs from unquestionably harmful water, but whatever it is that makes the trouble goes right through a filter like a fool through a fortune; and the filtration of the water through the stone, while it separates out all other known causes of disease, leaves the goiter-water as efficacious as ever.

Now along comes Dr. M. Wilms, professor of surgery at the University of Basel, and calls attention again to the fact that the regions in which goiter and cretinism are endemic are characterized by certain geological formations: goiter-water comes from strata that had been sea-bottoms in ancient epochs of the world's history, but never from over granite deposits or chalk or ancient lakes. Prof. Wilms then develops the theory that the disturbance in the thyroid gland is brought about by some subtle poison derived from the decomposition of animals and plants that turned to fossils ages ago.

This theory is in perfect agreement with the fact that goiter-water continues to be active when heated up to 50 to 75 deg. C. (122 to 167 deg. F.), but it is quite harmless if heated beyond 80 deg. C. (176 deg. F.). Many organic poisons are known that behave in just this way. The conclusions are based upon the results of experiments conducted with animals.

While the actual cause of these distressing disorders is not known, it is a step forward to know how to avoid the diseases.

Experiments on the Rusting of Various Sorts of Iron in Warm Water.

A series of experiments on the rusting of various sorts of iron in warm water has been made in the royal technical laboratory in Berlin at the instance of the German society for the promotion of arts and manufactures.

German and English tubes and plates of Siemens-Martin, Thomas and ordinary wrought iron were tested. The tubes, which were about 1 inch in diameter and from 11 to 14 inches long, were joined together to form a steam-heating coil in an iron tank, the tubes being electrically insulated from the tank and from one another, in order to prevent the generation of electric currents. The plates, some of which were 0.2 inch and some between 0.03 and 0.04 inch thick, were also insulated and were suspended inside the coil. The tank was filled with water, and steam at a pressure between 1.5 and 3 pounds was passed through the coil 6 hours daily.

The temperature of the water was about 194 deg. F. at the surface and ranged from 131 to 158 deg. F. at the bottom. In the first experiment, which continued three months, the water was drawn from the city mains and was frequently renewed, in order to bring air to the specimens in conditions similar to those of practice. At the end of this experiment all of the specimens were found to be thickly incrusted with boiler scale. In the subsequent experiments distilled water was used in order to prevent incrustation, and the water was aerated daily, before the steam was turned on, by forcing air through four pipes which descended nearly to the bottom of the tank.

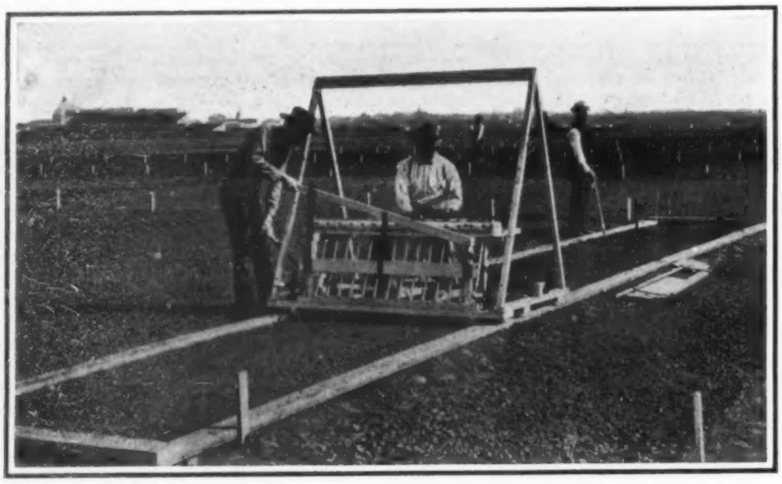
Very little difference was observed in the rusting of the various plates and tubes, except that plates which had been scoured with the sand blast were more affected by rust than specimens of the same sort of iron from which the "skin" produced by rolling had not been removed.

SCIENTIFIC BREEDING OF ANIMALS AND PLANTS

BY M. HAMILTON TALBOT

The problem of finding food for the new millions which are being added to our population—at the rate of 4,000 a day—with the area of the country not increasing at all, looks like a serious one. The solution, however, is found in the new science of breeding, which is adding other grains to the ears of wheat and corn, producing two blades of grass where one grew before, and giving us superior breeds of animals. The work accomplished by scientific plant and animal breeding in the past decade has already increased the value of our farm products from ten to twenty per cent, and ten to twenty per cent of increase on four billion dollars worth of our farm crops and three billion dollars worth of our animals means approximately a billion dollars annually in additional profits to our farmers, and all at a trifling cost. The investment of every dollar in scientific breeding yields a hundred dollars, or ten thousand per cent. Gold mines do not equal this. Luther Burbank, the dean of the American school of plant breeders, recently said: "The right man under favorable conditions can make one dollar yield a million dollars in plant breeding."

The twentieth century scientist in looking for food for the new millions found Nature too slow, so he took the grains and the fruits and forced the most astounding marriages; and in place of natural selection, the law of wild life, he has established artificial selection, which is a thousand times faster and a thousand times better adapted to human needs. He has created new wheats able to withstand great cold, new corns rich in fats or in proteids, new potatoes with a larger sugar content than ever before; he has developed hardy oranges, plums, apples, and other fruits; long-staple cottons, high-yielding cereal grains, and various other plants never before seen on our planet.



Planting centgeners (100 hill plots) in crop nursery.

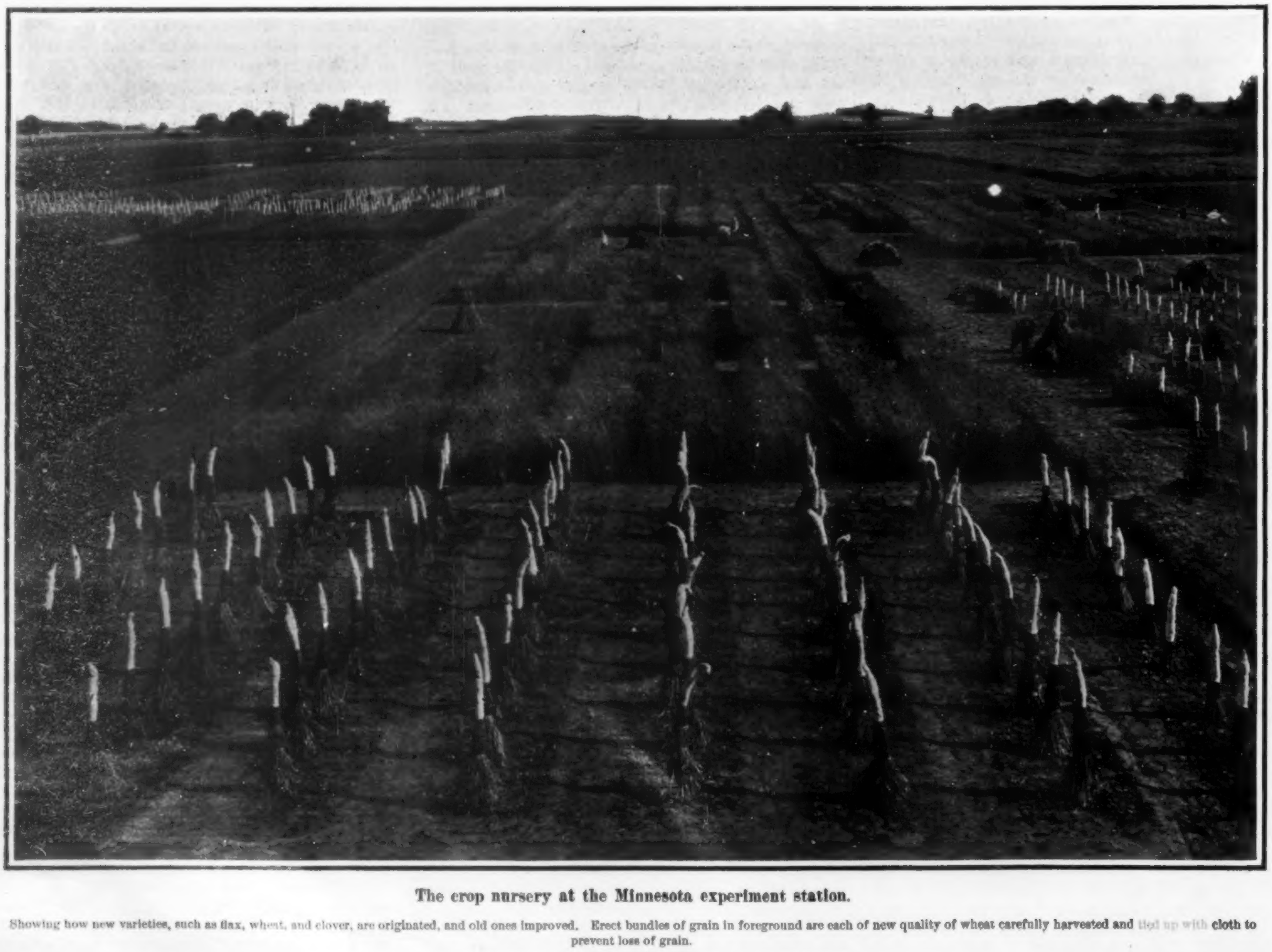
A seed is dropped into each cup and cups are emptied; then machine is drawn ahead four inches and seeds again planted.

Heredity is the science which is originating these new plants and new animals, and it is rapidly coming into man's hand to be used to increase production. Scientific breeders believe that every species can be improved by breeding, that every species has in it a blood strain with rare value for producing along desired lines, rare centgener power. The word *centgener*, which has been coined for use in expressing the breeding power of the individual plant or animal, is a combination of *centum* and *genera*, which means a hundred (more or less) of one birth having a common parentage. Breeders search for this phenomenal strain, and when found—the one in many—all others are discarded, and this superior blood is multiplied, and made to take the place of their half-civilized brothers. By this centgener method the breeder first secures many superior plants, and a hundred or more of each parent are planted; and by comparing the average of the progeny of the respective parent plants, the power of each parent to project its own individual values into its progeny is measured, and the seeds of those relatively few parent plants which beget the best strains are preserved and made into new pure-bred varieties. By this means the parent plants are

(*Continued on page 449.*)

Hybrid wheats produced by scientific breeding.

The two middle wheats are hybrids resulting from a cross fertilization of the two outside varieties.



The crop nursery at the Minnesota experiment station.

Showing how new varieties, such as flax, wheat, and clover, are originated, and old ones improved. Erect bundles of grain in foreground are each of new quality of wheat carefully harvested and tied up with cloth to prevent loss of grain.

SCIENTIFIC BREEDING OF ANIMALS AND PLANTS.

A TYPEWRITER THAT OPERATES WITHOUT NOISE

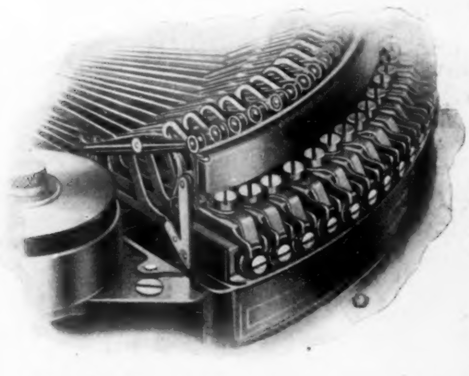
PRINTING BY PRESSURE RATHER THAN BY IMPACT

It seems hardly necessary to enumerate the various reasons why a noiseless typewriter should find favor among business men. Everyone who has had occasion to dictate letters directly to the machine, knows how difficult it is for the typist to catch every word spoken, and how as a consequence the copy thus produced is not apt to be as clean as one which is first dictated to a stenographer and then transcribed on the machine. The principal reason for the extensive use of shorthand in the business world is not because it is much speedier than typewriting, but because it is

Locking guide at the printing position.

absolutely quiet, and not liable to distract the dictator or anyone else in the immediate vicinity. For this reason the typewriter department of a large business concern is usually confined to a separate room, where the racket, though deafening, cannot disturb any but the operators of the machines.

Realizing this great drawback to the typewriter, inventors have long been endeavoring to overcome the noise of the machine in various ways. The latest effort in this direction does not concern itself with the attempt to produce a noiseless platen, or in any



Adjusting screws of the typebar movements.

other way to modify the present type of machine. Instead, it provides an entirely new machine throughout, in which a novel key action is employed. As a result, noise has been entirely abolished. One can make more noise with a pin than with this machine.

In the usual type of machine, the typebars are arranged in what is known as a "basket." From this normal position, a bar is lifted when a key is depressed, and is swung upward with increasing velocity until it strikes the paper like a hammer when at its maximum velocity. Necessarily, the blow delivered by a typebar thus slung at the paper must produce a loud noise. If a soft platen is used to cushion the blow, the result is a blurred impression on the paper. The new machine, however, does not operate on the hammer principle, but on that of the press. The types are carried on slide bars or plates, which are of skeleton form, in order to reduce weight. By a species of toggle action, the type is moved at high velocity to the printing position, but before it reaches this point, its velocity is checked, with the result that the type is merely pressed into the paper. The action is just as rapid as that of the hammer movement, the entire cycle of action occupying exactly the same amount of time, but in the one case the type reaches the paper when at its maximum velocity, while in the other when at almost a standstill.

One of the accompanying illustrations shows clearly the action of the key movement, showing the typebar in full, in the normal position, and in outline in the printing position. When the key is depressed, it throws a bell crank fitted with a roller that engages a cam slot in a hinged link. The roller travels in this cam slot, depressing the link, and thereby moving the typebar to the printing position. The toggle action of the link and the bar connecting this link with the typebar causes the latter to move very rapidly at first, but brings it to a stop just as it reaches the printing position. The typebar cannot move beyond the printing point, for when this point is reached the cam roller moves idly down the slot in the link if the key is further depressed. No matter how quickly or slowly the key bar is moved the typebar moves to the printing position with the same pressure, producing a uniform impression.

The general appearance of the machine is shown in another of the illustrations. It belongs to the "visible" class, the writing being in plain sight of the operator. The sliding typebars are located under the sector-shaped cover at the forward part of the machine. They are arranged to slide radially to the printing position.

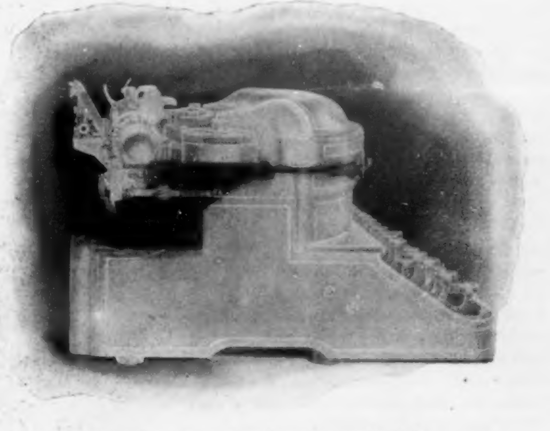
They are guided on the plate upon which they slide by two rows of pins arranged in concentric arcs struck from the printing point as a center. As the typebar is moved forward, it enters a guide at the printing point and is here locked against lateral movement. It might be supposed that in the case of typebars moving in from the sides there would be a side thrust due to the fact that they do not press the paper perpendicularly. This is prevented by the guides referred to. The guideway consists of a short slot perpendicular to the face of the paper, and in entering this slot from the side, the typebars must be slightly flexed. In this way, each typebar at the end of its path is made to move perpendicularly to the paper and always in perfect alinement.

In order to procure a clean-cut impression, and one that is not liable to become any worse with wear, a flat steel platen is used. The paper is carried and fed to the printing position on a soft rubber roll, but at the printing position it passes over a steel bar which provides it with an inflexible backing. There is no danger of bothering the types or marring them, because they are pressed against this bar instead of being hammered against it. Because of this inflexible backing, a uniformity of impression is secured. Whether the character is a small one or one of broad face matters not at all. There is never any danger of puncturing the paper. A row of period points, whether made with a heavy or a light touch of the key, will present an absolutely uniform dot throughout. The typebar movement is so arranged that it may be separately adjusted toward or from the printing position by turning a screw.

Since this machine uses the principle of the press rather than the hammer, it is essential that the bar against which the printing is to be done, should have

Slide plate and guide pins.

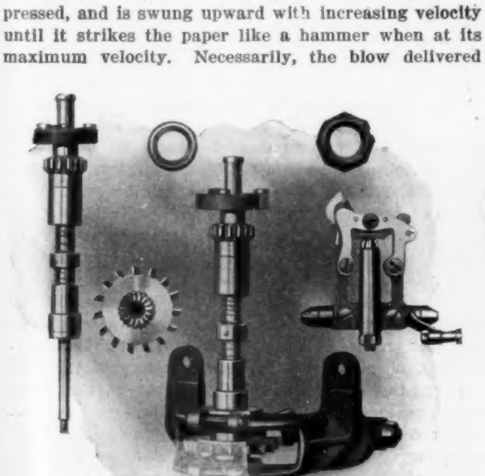
a firm and solid backing. This is provided for as shown in the phantom side view of the machine. The part shown in heavy shading performs this office. A tie rod passes through the center of the machine, and supports the carriage at the rear. At the front of the machine, where the tie bolt projects, there is a dial and pointer. By turning this pointer one way or the other the carriage may be moved bodily toward



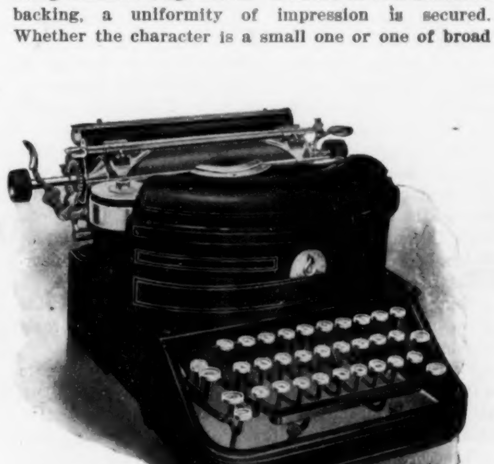
Phantom view showing the central tie.

or from the printing point. By means of this adjustment, the impression may be made heavy or light, as desired, and the machine may thus be adapted to manifolding, the position of the platen being regulated according to the number of copies desired. Another advantage of this arrangement is the fact that when introducing a word or sentence into copy already made, the impression may be regulated so as to conform to the heaviness or lightness of the type in the copy. As the printing is done against a flat steel

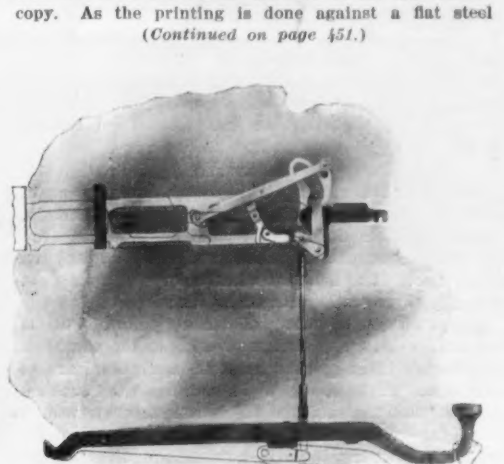
(*Continued on page 451.*)



Silent escapement showing the spherical bearing.



General view of the machine.



The key and typebar movement in two positions.

A TYPEWRITER THAT OPERATES WITHOUT NOISE.

THE HEAVENS IN DECEMBER

BY HENRY NORRIS RUSSELL, PH.D.

COMETS have certainly been the principal astronomical features of this year. The brilliant visitor of last January is now far out of sight, but Halley's comet is still telescopically visible in the morning sky, and—being recently reported as of the eleventh magnitude—will probably be followed some time longer by powerful telescopes. Metcalf's comet, discovered in August, is receding, too, but now comes the news of an additional discovery, by Cerulli, early in November. This comet is fairly bright, and is visible in a small telescope. The first computation of its orbit—by Mr. Levy of the University of California—shows that it is not a new comet, but a return of a well-known one—Faye's comet—which has been regularly observed at its returns every seven and one-half years since 1843, except in 1903, when it was unusually far from the earth and on the other side of the sun. This year it is in almost the best possible position, as near us as it can ever come. On November 12th it was at the point of its orbit nearest the sun, and 152 million miles from the latter, while the earth was almost in line between the two, and little more than 60 million miles from the comet. The published ephemeris of the comet's motion stops on November 27th, on which date its position is R.A. 3h. 36m. 47s., declination 4 deg. 49 min. north, and it is moving 5 seconds west and 10 minutes south per day. As its apparent motion is almost rectilinear, and at a decreasing rate, it should be easy enough to pick it up, provided one has a telescope of three or four inches aperture.

It may seem surprising that so well known a comet should reappear, and be under observation for a week, before it is recognized; but we must remember that all faint comets look very much alike, and that none of them has any individual likeness, so to speak, which would enable us to tell them apart by their appearance. The return of a periodic comet cannot be recognized until its orbit has been completed, and it has been found to follow the path of some earlier comet.

In the present case, it would have been possible to predict this comet's place in advance, as was done for Halley's comet; but this does not seem to have been done—probably because the comet was near Jupiter in 1899, making the necessary calculations of the changes in its orbit very laborious; and the failure to see it in 1903 discouraged computers from further work.

THE HEAVENS.

The splendid winter constellations are now again well seen in the evening sky. Low on the horizon, about E.S.E., is the incomparable Sirius, which even at this low altitude shows its great superiority to the other stars. The brilliant white color which its light actually possesses is changed by the refraction of our atmosphere into a variety of dancing colors. This is no more evidence of change of color in the star than the flashes of color reflected from a diamond are of alterations in the sunlight. In both cases the explanation is that the medium which reflects or transmits the light—in our case the diamond, in the other strata of air of varying density—now deflects light of one color into our eyes, and now another.

Sirius shows these effects unusually well, just because it is so bright. (Changes of color in a faint object are difficult, if not impossible, to see.) They become still more striking when a field glass is used; and by oscillating the glass slightly, so that the star seems drawn out into a line of light, this appears of very variable brightness, and beaded with the most brilliant colors. On a calm, still night, when the stars twinkle but little, this phenomenon is inconspicuous; but the sharp, cold, windy nights of winter show it in a highly developed form—far too much so for the peace of the astronomer; for this same "bad seeing" confuses the telescopic images so much that most forms of observation are made almost impossible.

Above Sirius is the splendid figure of Orion, above which again is Taurus, with the ruddy Aldebaran and the Pleiades. The Little Dog, with his one bright star Procyon, is due east. Above him are the Twins and still higher the Charioteer, Auriga, and then Perseus almost overhead.

The southern sky is far less showy. Aries, just south of the zenith, contains one fairly bright star, and the much brighter planet Saturn—which at our hour of observation is almost due south. Below him, in the southern sky, is the huge constellation Cetus.

Our initial, which faithfully represents the traditional figure of this sea monster, and shows how far it differs from a whale. It is truly formidable in aspect, anyhow, and looks quite capable of devouring poor Andromeda at one gulp.

The constellation, though so large, contains only one star as bright as the second magnitude—β Ceti—which stands very much alone, south of the eastern edge of the great square of Pegasus. Next, to the left, is an irregular quadrilateral, the southernmost star of which, τ Ceti, is noteworthy as one of the very nearest stars—its light taking only ten years to reach us.

Next in order to the eastward is the variable star Mira, now diminishing in brightness, and scarcely visible to the naked eye.

Finally, at the other end of the constellation, is α Ceti, a little below the second magnitude, and γ Ceti, about a magnitude fainter, which has a companion about 1/30 as bright as itself, at a distance of 3 sec., and, according to recent observations at Yale, has the relatively large parallax of 0.12 sec., corresponding to a distance of 27 light years.

The still duller area of Eridanus fills the southeast between Cetus and Orion, while in the west we find Andromeda, almost overhead, Pegasus below her, and Aquarius near the horizon. Cygnus and Lyra are low in the northwest, Draco and Ursa Minor below the Pole, Ursa Major coming up in the northwest, and Cassiopeia and Cepheus high up, to the left of the Pole star.

THE PLANETS.

Mercury is evening star all through the month, but is exceedingly far south, and so not well observable. The best time to look for him will be in the neighborhood of the 24th, when he is apparently farthest from the sun, and sets about 6 P. M.

Venus is just past conjunction with the sun, and is theoretically an evening star, but sets even earlier than Mercury, and is hardly observable.

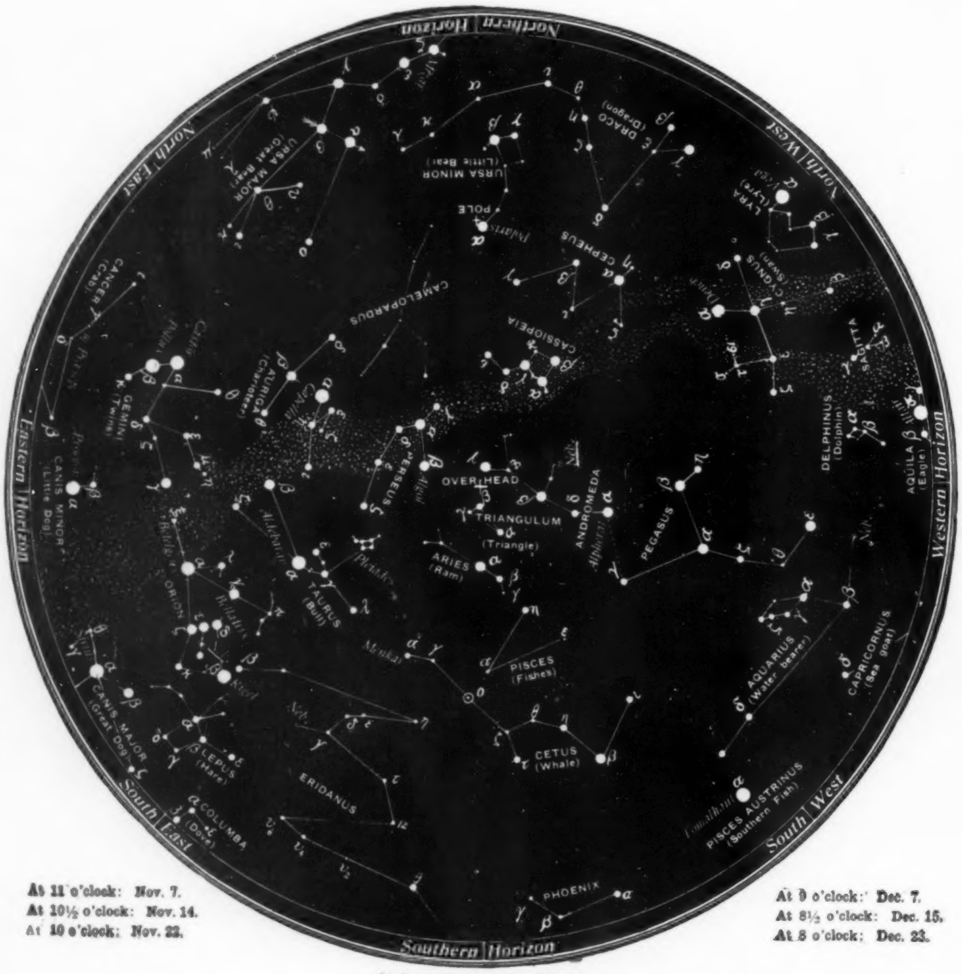
Mars is morning star in Libra and Scorpio, rising about 5 A. M. On the 23rd he is close to the bright star β Scorpii. Jupiter is in Virgo, and is likewise a morning star, rising about 3:30 A. M. in the middle of the month. Saturn is in Aries, and comes to the meridian about 8 P. M. in the latter part of the month.

Uranus is in Sagittarius, too near the sun to be observed. Neptune is in Gemini, approaching opposition, but is invisible except with a telescope, and cannot be distinguished from the neighboring stars, except with a powerful instrument.

The moon is new at 4 P. M. on the 1st, in her first quarter at 2 P. M. on the 9th, full at 6 A. M. on the 16th, in her last quarter at 5 A. M. on the 23rd, and new again at 11 A. M. on the 31st. She is nearest the earth on the 15th, and farthest away on the 27th. In her circuit of the sky she passes Venus on the 1st, Mercury on the 2nd, Uranus on the 5th, Saturn on the 12th, Neptune on the 18th, Jupiter on the 26th, and Mars on the 28th.

The conjunction with Saturn is interesting, as the moon passes in front of the planet, occulting it for nearly an hour. This happens before sunset; the planet, as seen from Washington, disappearing behind the dark limb of the moon at 2:54 P. M., and coming out on the other side at 3:48—but a telescopic view may nevertheless be of interest. For other points in the Eastern States the times will be somewhat different.

Princeton University Observatory.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9½ o'clock: November 30.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

NIGHT SKY: NOVEMBER AND DECEMBER

In an article on gold leaf in the April Magazine of Commerce, Mr. John Mastin says that just as the date of the discovery of gold is too remote even to be guessed at, so is the origin of gold leaf lost in antiquity. On some of the most ancient mummies discovered, gold leaf has been used on the skin, tongue, and teeth, etc., and in some instances on the coffins also. It also appears on tombs, monuments, and the like; and, strange to say, though gilding with "thin sheets of hammered gold," and "skins of gold"—otherwise gold leaf—was known to be practised at least in the eighth century B. C., the process of bringing the gold into these fine sheets, or "skins," was, at any rate in the eleventh century A. D., substantially the same as that used to-day, no advance whatever having been made in the intervening nine centuries. Further, on some of the Grecian pottery of the fifth century, the golf leaf used is as thin as that used to-day, so that in results obtained, also, we have not advanced in the least, but still keep practically to the same average thickness as that used on the Egyptian coffins of the third century A. D., and most of the Greek vases of the fifth.

Lieut. Mente, an army aviator, was killed at the aviation meeting of Magdeburg on October 25th. The details of the fatality are unavailable.

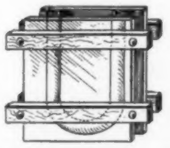
[The Editor of the Home Laboratory will be glad to receive any suggestions for this department and will pay for them, promptly, if available.]

ELECTRICAL PROJECTION EXPERIMENTS.—II.

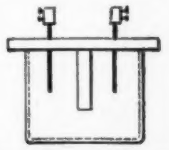
BY SYDNEY WHETMORE ASHE.

(Continued from the issue of November 5th, 1910.)

How to Use a Sensitive Galvanometer for Projection.—An ordinary laboratory galvanometer may be used to advantage to perform on the screen all of the experiments ordinarily performed in the laboratory. A card containing a small slit is inserted in the slide carrier of the lantern, and the slit focused so that the beam of light strikes the mirror of the galvanometer, and is reflected to a scale fastened on the wall of the lecture room. The lantern is turned "hind side to," and is raised at an angle, so that the galvanometer mounted about six inches above the lantern base will be able to swing its light beam back and forth without striking the lantern. A large scale about 20 feet long, with black markings, ½ inch by 2 inches, may be drawn on Manila paper and mounted on the screen.

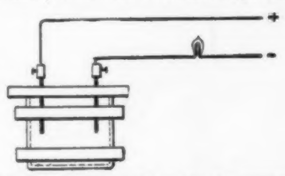


SIMPLE PROJECTING TANK.



ELECTROLYSIS PROJECTING TANK.

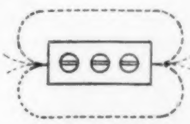
Among the experiments which may be performed with this set-up are the measurement of the sensitiveness of a galvanometer, determination of its resistance and its constant, Wheatstone bridge methods of measuring resistance, Thomson double-bridge methods, calibration of a voltmeter with a potentiometer and a standard cell, measurement of insulation resistance, etc.



DECOMPOSITION OF ACID SOLUTIONS.

In measuring the sensitiveness of a galvanometer, a very high resistance is placed in series with the instrument, and its deflection noted. For instance, 500,000 ohms placed in series with the galvanometer and 2 volts of battery would produce a deflection of about 20 scale divisions with an ordinary galvanometer. It is well in all galvanometer projection experiments to work with a shunted galvanometer, so that the light spot will keep somewhere near the scale, and not travel all over the room. The shunt may be removed when a balance is made. It is also well to have some idea of the exact manipulation to be made, so that too much time will not be wasted in making measurements. The galvanometer suspension should be banked up to the time that the experiment is to be performed, as too much vibration, due to people moving about, may result in fracture of the suspension. When a galvanometer is being used in conjunction with a standard cell, a projecting voltmeter, and a potentiometer, the voltmeter scale which is being calibrated may be projected on the screen.

METHOD OF PRODUCING ERECT IMAGE.



PATH OF LINES OF FORCE.

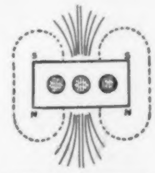
Electrolysis Experiments.—Many electrolysis experiments may be performed on a projecting lantern. These include the electrolysis of water, slightly acid, with platinum electrodes, electrolysis of sodium acetate with copper electrodes, electrolysis of sodium acetate with platinum electrodes in a divided tank with phenolthalein added, formation of a lead tree, electrolysis of lead acetate.

An experiment tank for projecting purposes to be used on a horizontal lantern can be made by taking two pieces of glass, 3/8-inch plate glass, 4 inches by 5 inches, and separating them by a piece of rubber gas tubing bent in the form of a U. The tank may be held together by two clamps made from thin cedar, held together by 8-32 machine screws. The advantage of a simple tank of this kind is that it may be readily taken apart and cleaned, and that liquids can remain in it for some time. Such a tank, indeed, is superior in every way, except perhaps in appearance, to one that is cemented.

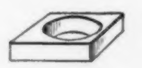
Use of Experimental Tank.—Place two copper electrodes in a projecting tank containing a solution of sodium acetate. The writer prefers this to hydrochloric acid, as the latter attacks the sides of the tank if they happen to be of metal. Insert a reversing switch in series with a 16-candle-power lamp and a 116-volt direct-current service. When the current is on, notice that gas only rises—oxygen—from the positive electrode, the hydrogen evolved at the negative electrode attacking the copper electrode. Throw the reversing switch, changing the direction of the current through the cell, and notice a black deposit rise from the former negative electrode. This is some form of hydride of copper which is being carried up by the oxygen gas. This experiment proves the second step in the electrolytic process, namely, that the anions are going to the anode, or positive electrode, and that the kathions as electro-positive are being attracted to the kathode or negative electrode. In order that an image of a projecting tank may appear in normal position instead of upside down, a 45-deg. to 90-deg. prism may be used to erect the image. This prism should be placed before the objective lens, as in the illustration. The prism will have to be mounted as close to the face of the lens as possible, otherwise it will not entirely cover the image.

Alternating Current Projection Experiments.—Two lanterns are preferable in performing alternating-current experiments, as it is almost always necessary to take simultaneous readings of voltage and current. Sometimes a third lantern could be used, as in power measurements, but in such cases it is often possible to get along with simply two lanterns, as the voltmeter may be used first, and then simultaneous readings of current and wattage taken. An instance of this is in the measurement of the power factor of an alternating-current arc lamp. The lamp may be left burning over the lecture table, and the voltage across its terminal, which will be fairly constant, noted. The wattmeter may then replace the voltmeter on one lantern, the ammeter being projected by the other lantern on scale above the other, and simultaneous readings of voltage and current noted. The power factor may then be calculated by the well-known formula:

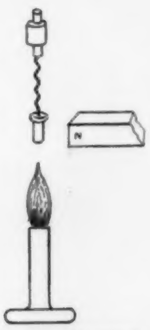
$$\text{Power factor} = \frac{\text{watts}}{\text{volts} \times \text{amperes}}.$$



CROSS MAGNETIZATION.



THE SHAKER.



MAGNETIZATION LOSS WITH HEAT.

Capacity and inductance may be measured by the projecting ammeter and voltmeter, and treated by means of vectors. An interesting experiment is to form a series circuit of capacity inductance and resistance, measure their individual differences of potential, and show that the total E.M.F. is greater than the line E.M.F. In a somewhat similar manner, a multiple circuit may be used, in which it may be shown that the sum of the individual currents in the different legs of the circuit is greater than the line current. Numerous experiments on transformers, rotary converters, and induction motors may be performed upon the screen, in addition to the many striking experiments on these machines which may be performed on the lecture table.

Among the many attractive experiments on magnetism the following will no doubt be of interest.

Path of Lines of Force Through Iron.—While we feel certain that lines of force pass in straight lines through iron, any simple experiment which will show this phenomenon will add to our conception of the subject. To perform these experiments, secure some discarded Gillette safety razor blades, which contain small circular holes and are made of good steel. Magnetize these blades by any of the well-known methods. Magnetize one blade so that the lines of force will pass parallel to the longer side, and then magnetize another so that the lines of force will pass parallel to the short side, or what might be termed for convenience cross magnetization. Cover each one of the blades with a thin piece of glass, and sprinkle iron filings over the glass. Tap the glass, and notice particularly the direction of the lines of force over the holes in the razor blades. In one case they will be parallel to the longer side of the blade, and in the other case they will be parallel to the shorter side, as in the illustration. A convenient shaker can be made by covering a hole in a piece of wood with a fine-mesh wire netting.

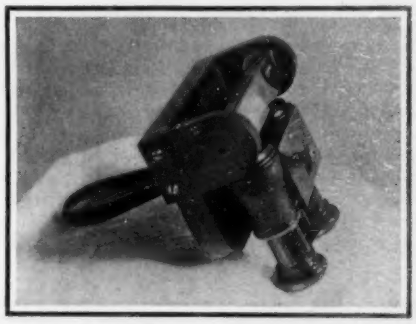
Experiment.—Mount a small wire nail upon a piece of platinum wire and suspend it from a support in a clip stand. Heat the nail to redness by a Bunsen burner, and then bring a magnet into proximity to the nail, noting that the nail is not attracted to the magnet. Watch the nail cool, and notice that, as its temperature lowers, owing to the absence of the Bunsen burner, a critical temperature is reached where the nail is suddenly attracted to the magnet.

(To be concluded.)

SIMPLE SPECTROSCOPE FOR STUDYING BRIGHT-LINE SPECTRA.

BY HOWARD B. DAILEY.

Through its possession of certain convenient physical qualities whose utilization brings the experiments here presented easily within the province of the home laboratory, the common spark discharge from the static electric machine affords conditions readily favorable to the production of a curious modification of the lined spectrum, whose unusual aspect and singular beauty give to it a peculiar interest.

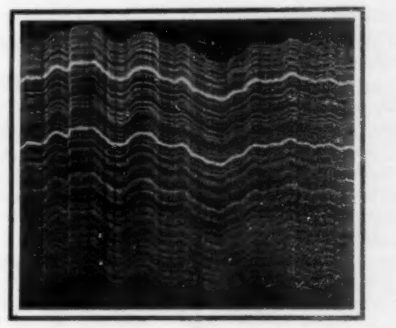


SIMPLE SPECTROSCOPE FOR SPARK DISCHARGES.

If the experimenter has at hand a good influence machine yielding sparks four or five inches long, the only accessory apparatus required for observing these effects are a pair of common opera glasses and a five-inch equilateral glass prism. These are made to constitute the essentials of a simple spectroscope with which full-length spark discharges can be conveniently viewed.

The opera glass is fixed upon a base board provided with a handle on its under side, the axes of the tubes being made parallel with the surface of the base board. The eyepiece end of the opera glass is supported by the middle cross bar of the instrument upon a small block of wood rising from the base. The opera glass is held in position by a broad sheet-brass binding plate provided with a clamping stud and thumb nut. The plate, which extends across both barrels of the instrument, has a rectangular aperture through which the focusing screw can be reached.

The prism, whose ends should be square, is supported close in front of the opera glass by two uprights attached to the base at its front end, the inner faces of the uprights being provided with shallow circular recesses, into which the ends of the prism fit rather snugly to enable it to remain in any position. The axis of the prism should be raised about three-sixteenths of an inch above the plane of the axes of the tubes of the opera glass.



SPECTROGRAM OF A SINGLE SIX-INCH LEYDEN-JAR SPARK.

The usual collimating lens in front of the prism for rendering parallel the entering rays is here dispensed with, sufficient collimation of the incident rays being effected by having the spectroscope and the sparks to be viewed separated by a distance of about 15 feet, a procedure which the abundance of light furnished by the spark makes readily feasible. The

slit mechanism of the regular spectroscope for narrowing the source of light to an exceedingly fine line is also omitted, the extreme tenuity of the spark enabling the latter to act as its own "slit."

There is a position of maximum efficiency for the prism relative to the axis of the tubes of the opera glasses which is found as follows: With the prism first adjusted so that its front or outward face is perpendicular with the base board, look through the instrument at a candle flame, or other luminous object until its colored spectrum is seen. Now, holding the instrument quite steady, begin slowly revolving the prism's upper edge forward. The spectrum of the flame will be seen first to rise slightly, then come to a standstill, and finally begin to descend. When the flame spectrum is at its highest point or position of temporary rest the proper adjustment has been attained, and it will now be found that the prism's front face makes an angle of about 76 deg. with the base board. The prism has now been set to the "position of minimum deviation," the condition sought by the spectroscopists for maximum efficiency.

The sparks to be viewed should be not less than four inches in length, and must be the bright detonating discharges from the Leyden jars of the machine. In using the instrument the prism is held parallel with the general direction of the spark's axis, and at a distance from it of about fifteen feet.

A long spark viewed through the instrument in a darkened room presents a beautiful and interesting appearance. The spark, with all its many eccentricities of form, divides itself laterally into numerous brilliant variously colored separate counterparts of itself, arranged in beautiful sinuous parallel strata, the light of different wave lengths each producing its own distinct characteristically colored spark image or "line."

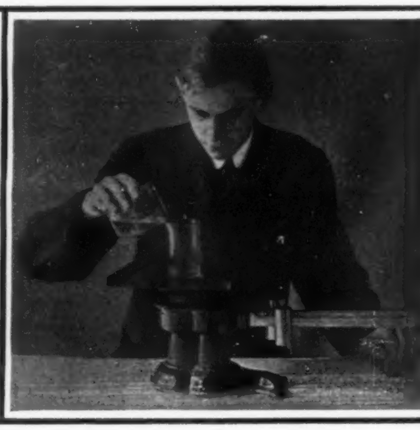
While the accompanying illustration may give a fair impression of the general aspect of the spectrum as to detail of form, it can of course afford no conception of the brilliant diversities of color and exquisite contrast and gradations of tint and luminous intensity which the various spark groupings and lamina present. The spectrum is crossed in many places by dark lanes or vacant spaces telling their story of missing wave lengths; while among the brighter separate lines are two especially prominent ones, a gleaming yellow, and farther down a fine bright metallic green. Owing to the advantages of binocular vision here afforded the spectrum has a beautiful appearance of transparency and relief difficult to describe.

If the influence machine is of sufficient power to produce six or eight inch sparks in an apparently continuous stream the spectrum of such a discharge becomes a magnificent sight. The constant contortions of the discharge cause the spectrum to become a writhing, waving band of gleaming colors, striped and lined with quivering bars of many hues like a fiery flag threshing in violent winds.

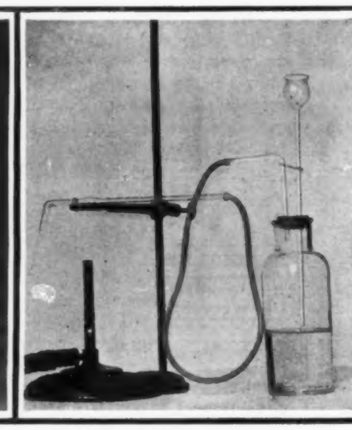
Careful attention must be given to proper focusing of the opera glass, much of the clearness of lineation depending upon this consideration. A curious modification of the appearance described above may be effected as follows: Hold the instrument to the eyes and slowly rotate the prism forward until the spectrum descends to its lowest position, keeping the spectrum constantly in view by following up its downward movement with a corresponding lowering of the instrument, until the spectrum has reached its last possible position of visibility. When this condition is attained the spectrum has lost much of its brilliancy and many of its separate lines; but those that do remain, of which there are still several bright ones, have become perfectly straight, giving the spectrum the familiar straight line aspect of ordinary spectroscopy. This seems an interesting circumstance in view of the extremely crooked nature of the "slit" in the present instance.

1.—Producing carbonate of lime.

2.—Extinguishing a lighted taper.



3.—Weighing carbonic acid gas.



4.—Depositing carbon from gas.

SIMPLE EXPERIMENTS WITH CARBONIC ACID GAS.

BY A. J. JARMAN.

Many very interesting experiments may be performed with carbonic acid, that do not call for any elaborate apparatus. The following suggestions are particularly adapted for the novice.

A few articles will be required, such as lime water, bicarbonate of soda, and four ounces of sulphuric acid, and a couple of pieces of glass tubing 8 inches long with a bore of 3/16 inch in diameter. If the lime water is not readily procurable, it can be easily made in the following manner: Procure three or four pieces of quicklime about the size of one's fist. Place these in a stone pitcher. Pour about four pints of cold water upon them. The quicklime will soon disintegrate, or slake as it is termed. The mixture must be well stirred. It will also become very hot. Now allow it to stand in a cool place for twelve hours, and then pour off the clear liquor, after removing the slight film that forms on top (this thin film is carbonate of lime). The clear liquor is the lime water required, and must be kept in a well-corked bottle. About 1½ pints will be the result, and this must be quite free from deposit.

Pour a small quantity of this liquor, about 2 ounces by measure, into a clean glass tumbler; take one of the pieces of glass tubing, and place one end into the mouth, allowing the other end to dip far down into the lime water. Now blow the breath through the lime water, causing it to bubble actively, when it will be found in the course of about half a minute that the lime water has become turbid. Continue the blowing for another half minute, and then examine the liquid. There will be found a moderately dense white deposit. This deposit is carbonate of lime, produced by the carbonic acid gas contained in the breath, combining with the lime in the water. Several such tests should be made, and the whole placed in a small glass funnel fitted with a clean light filter paper. The paper should be weighed before filtering and again after the filtered matter has dried upon the paper. The excess of weight will represent the carbonate of lime, or chalk, the carbonic acid gas (CO_2) in the breath having been produced by the combustion of the carbon contained in the food by the oxygen in the air we breathe.

Place into a glass tumbler a teaspoonful of bicarbonate of soda; add 2 ounces of cold water. Prepare in another tumbler a mixture of 3 ounces of water and 2 drachms of sulphuric acid. Stir this with a glass rod. Pour 1 ounce of this liquid into the bicarbonate of soda solution; considerable effervescence will occur. Now dip a lighted match into the upper portion of the tumbler; it will become extinguished instantly. Dip a lighted wax taper into it; this light will also become extinguished. Add another ounce of the acid solution to the bicarbonate, and then during effervescence carefully tilt this tumbler so as to pour the invisible gas above the liquid into an empty tumbler. (Do not allow any of the liquid to pass.) Upon dipping a lighted taper or match into this apparently empty tumbler, it will become immediately extinguished. This experiment, which is shown in Fig. 2, proves that carbonic acid gas, although invisible, has weight, and may be poured just like a liquid.

Now place a clean, dry, empty tumbler upon a scale pan, and adjust the scale so that the tumbler balances. Pour another ounce of the acid into the bicarbonate tumbler after adding another teaspoonful of bicarbonate of soda. While the mixture is effervescing pour the gas (not the liquid) carefully into the tumbler on the scale pan. Almost instantly the balance beam will turn, and the tumbler will go down suddenly, showing that the gas has not only weight, but is also a very heavy gas (Fig. 3). It is because of its great weight that this gas remains within the workings of a coal mine after an explosion; hence the name "after damp."

The following experiment, if carried out carefully, will prove the value of plant life in absorbing carbon and restoring oxygen: Procure a large glass fish globe; pluck some fresh leaves from a grapevine, fill the globe three parts full, generate some carbonic acid gas as above described, and fill the globe by testing with a lighted taper. Then place the globe, covered with a well-fitting dinner plate, into bright sunlight. Allow it to stand for about an hour, after which insert a lighted taper. Instead of instant extinction of the light, a surprising reverse effect will be produced. The light of the taper will burn more brilliantly than in common air, although not quite as brilliant as in pure oxygen. It will illustrate that the vital energy of the freshly plucked leaves possesses the wonderful property of retaining the carbon of the carbonic acid gas and liberating the oxygen.

Although carbonic acid gas is quite invisible in its ordinary state, and is also transparent, it may be shown to contain carbon by the following experiment: Obtain what is known as a small combustion tube, from any dealer in chemical glassware, shaped like the one shown in Fig. 4. Place in the bulb a pellet of the metal potassium, about the size of a pea, or perhaps two pieces will determine the question better. Now attach a piece of rubber tubing to the end of the combustion tube, and apply it to the outlet of the gas bottle as shown, having previously placed in the bottle one ounce of bicarbonate of soda and four ounces of water. Place the flame of a spirit lamp or Bunsen burner beneath the bulb, and pour into the thistle tube 1 ounce of diluted sulphuric acid. Immediately the carbonic acid gas (CO_2) is liberated, and on passing over the melted potassium the oxygen combines with the metal, and the carbon becomes deposited as a black powder. The generation of the gas must be repeated two or three times; the India rubber tube disengaged, and the combustion tube allowed to become cold. The bulb may now be broken, and the contents placed in a clean tumbler or glass beaker, and 2 ounces of distilled water added. If a trace of the metal potassium remains, it will instantly ignite the hydrogen contained in the water. This will prove of no consequence. Add 1 ounce more of water, then place the whole of the contents in a clean filter paper fitted into a glass funnel. When filtered, pour 4 ounces more of distilled water in the filter paper. When this has passed through, dry the paper. The black powder is the carbon (or charcoal) contained in the gas. In all these experiments, where bicarbonate of soda has been used in combination with diluted sulphuric acid, the latter has combined with the soda, forming sulphate of soda, while the carbonic acid contained in the bicarbonate has become liberated. Many substances can be used, such as granulated marble, common chalk, carbonate of lime. Bicarbonate of soda is best suited for all experimental purposes.

When we consider that an adult draws in at each respiration about forty cubic inches of air, and in the course of twenty-four hours respires four to five thousand gallons, it will be readily seen that a human being generates an enormous quantity of carbonic acid gas. This fact alone should prove the necessity of good ventilation in our dwelling rooms, and the sleeping apartments in particular.

The following simple experiment will prove the presence of carbonic acid in a close sleeping apartment: Pour a quantity of the lime water previously described into a large tea saucer. Allow it to stand upon a stool or box about one foot from the floor. In the morning it will be found that a slight crust has formed all over the surface. Upon tapping this crust with the handle of a teaspoon the broken crust will fall to the bottom. Draining off the clear liquid, this crust will be found to be carbonate of lime, formed by the carbonic acid from the breath and partly from combustion.

RECENTLY PATENTED INVENTIONS.

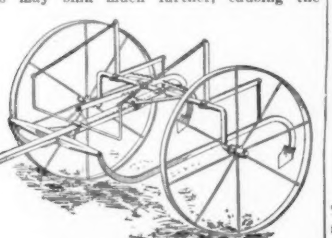
Pertaining to Apparel.

SPRING FOR FLEXIBLE CONNECTIONS. —J. H. O'Brien, Ilion, N. Y. The invention is of peculiar service in flexible connections used for articles of clothing, such as suspenders, garters, armlets, and the like. It comprehends a flexible strap incapable of stretching, and a spring and guide members connected with the strap in such manner that the virtual length of the strap may be varied by aid of the tension of the string.

Of Interest to Farmers.

BEET TOPPER AND DIGGER.—J. Devey, Lehi; J. Devey, Jr., Garland, and W. A. Devey, American Fork, Utah. The intention in this case is to provide a simple, compact, and easily operated device which will top the beets and remove the crown and top to one side of the row, and will afterward lift the beets and separate them from the soil, and wherein the cutter may be adjusted to cut the crowns at the desired spot.

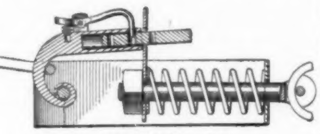
CULTIVATOR. — William S. Wilburn, Simmons, Mo. In the use of riding cultivators, the variation of the soil in respect to hardness and softness offers great difficulty. The plows may be set to run two inches deep, while the wheels sink normally about half an inch, but when soft soil is encountered the wheels may sink much farther, causing the



ADJUSTABLE CULTIVATOR.

plows to sink say, three or four inches, and thus the plants are liable to be entirely covered. The cultivator illustrated herewith is arranged to overcome this difficulty, enabling the driver to regulate the depth regardless of the condition of the soil, and regardless of whether one wheel sinks farther than the other.

CLEVIS.—Nels A. Niemie, Box 28, McKenzie, N. D. The adjustable clevis shown in the accompanying drawing is adapted for use particularly on plows and similar agricultural implements. The object of the device is to permit of immediate disconnection whenever necessary to prevent the danger of breaking. If, for instance, the plow should strike a stone, which the horse is not strong enough to dis-



CLEVIS FOR PLOWS, ETC.

lodge, there would be a tendency to break the harness of the plow, but with the use of this clevis, the pull of the horse will disengage the locking plate, permitting the clevy bar to swing open and disconnect the plow from the horse. After the stone has been dug away, or the plow lifted around it, the horse may very readily be reconnected to the plow.

Of General Interest.

FOUNTAIN-CUSPIDOR. — J. D. Wilson, Webster Groves, Mo. The construction of this article for use by dentists and others, embodies a saliva receptacle, a basin forming the mouth of the receptacle, a water reservoir upon which the receptacle is seated, a chamber at the bottom of the reservoir provided with a water inlet valve, a discharge conduit leading from the lower portion of the chamber to the bowl, and an air compressor discharging into the chamber to expel the water therein into the bowl through the conduit.

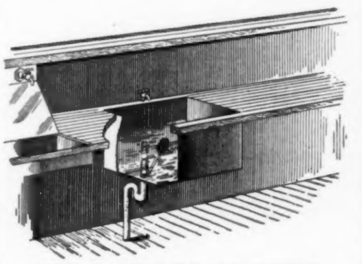
DISCHARGE-HEAD FOR COLLAPSIBLE TUBES.—O. Gerdtzen, Valparaiso, Chile. The improvement is in discharge heads for collapsible tubes, more especially such as are used for dentifrices in the form of paste or cream, and has in view a relatively long and narrow discharge head undercut at opposite sides, and a spring clip cover adapted to removably seat on the head over the discharge and engage the opposite sides of the head below the maximum width of the upper portion.

SAND-WHEEL.—G. H. Davidson, Morenci, Ariz. The invention relates to a wheel adapted to take the coarse sand out of an ore, such as copper sulfid, after it has been crushed and ground; and particularly relates to a type which is adapted to separate the sands from the slimes and water, and may be used singly, or a plurality of them in series.

CAR SUSPENSION FOR AIRSHIPS.—G. A. Crocco and O. Ricaldoni, Rome, Italy. These captains in the Aeronautical Brigade have invented means for suspending the car of dirigible airships, and connecting the same with the gas bag, and the invention comprises a novel arrangement of parts applicable in all cases, but particularly advantageous when a short car has to be suspended by a much longer balloon hull.

WATER-DRAIN FOR BUILDINGS.—F. S. Bieber, Poughkeepsie, N. Y. This invention provides against accumulation of water on one floor from flowing to stories below in case of water used in a fire; provides means of this character which can be incorporated in buildings under construction, and applied to old buildings; provides automatic devices to deflect water introduced into a building or any particular story from passing below to stories at which water is so introduced, which operation is inaugurated by the fire; and provides a building with devices in such manner that will be unobtrusive.

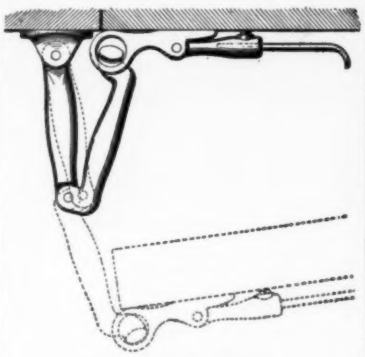
GLASS-CLEANER.—Louis G. Hatosy, Jr., 308 East 119th Street, New York. For the convenience of barkeepers and attendants at soda water fountains, a new fixture has been invented to permit of readily cleaning glasses.



GLASS CLEANER FOR BAR KEEPERS.

The device, as shown in the illustration, consists of a stationary brush submerged in the water of the washing tank and projecting upward in an inclined direction to permit of readily placing the glass over the brush and cleaning the glasses by turning it thereon.

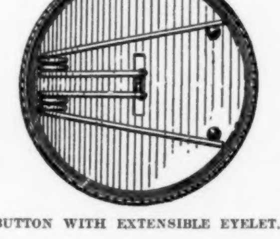
DOOR-CHECK.—Jacob Suter, 68 Webster Avenue, Jersey City, N. J. The object of this invention is to provide a check that may conveniently be attached to a door, to allow partial opening of the door for ventilation when desired, or to securely lock the door in the closed position. Two rigid arms, pivotally



IMPROVED DOOR CHECK.

connected, are used, one being hinged to the door jamb and the other being detachably connected with the door. A locking member is arranged to engage the door arm at its pivotal connection with the door jamb arm to hold the door locked in closed position.

BUTTON.—Nels Tweet, care of Jorgen Howard, Hillsboro, N. D. The button pictured in the accompanying drawing is provided with an extensible eyelet adapted to conform to various thicknesses of material that are to be buttoned. The support of the eyelet is resili-



BUTTON WITH EXTENSIBLE EYELET.

ent, so that it will return to its initial position after being extended to button thick materials. It will be understood by reference to the illustration that the eyelet is an extension of a pair of spring coils fitted within the body of the button.

Hardware and Tools.

HANDLE-EXTRACTOR FOR AXES, HAMMERS, ETC.—J. Veno, Vancouver, British Columbia, Canada. The device embodies a clamp for securing the head of the tool, and a punch, preferably screw-actuated and supported from the clamp in a position to press on the handle, the punch being swiveled on the screw so that the latter will turn independently thereof, and removably applied to permit of a variety of punches of different sizes and shapes being used.

SPRINKLER.—C. A. Borgeson, San Francisco, Cal. The invention pertains to a device for use in sprinkling lawns, flower gardens, or the like, which is adapted to distribute an even shower of water as lightly as the rain, and covering every patch of the ground surrounding the device within certain limits, varying according to water limits.

Heating and Lighting.

AUTOMATIC CUT-OFF FOR GAS-MAINS. —C. E. Lahmers, New Philadelphia, Ohio. This device prevents explosions or accidents caused by changes in the pressure of gas mains. The inventor's aim is to automatically shut off the flow of gas from the mains when pressure becomes too low, thereby preventing accidents which might otherwise occur. The invention is similar to one disclosed in a prior patent granted to Mr. Lahmers.

Household Utilities.

BAKING-OVEN.—B. Nino, New York, N. Y. This invention relates to baking ovens, and has reference more particularly to an oven of this kind which has a baking chamber casing, a furnace, and flues arranged to encompass the baking chamber casing, so that the heat from the furnace is uniformly distributed about the casing.

CURTAIN-POLE CARRIER.—J. Kroder, New York, N. Y. The object here is to provide a carrier provided with pulleys for a draw cord employed for pulling the curtain open and shut, the carrier being arranged for use either as an outside carrier or for use between the jambs of a door or window frame, or for suspension over an overhead support such as the ceiling or the cross bar of a door or window frame.

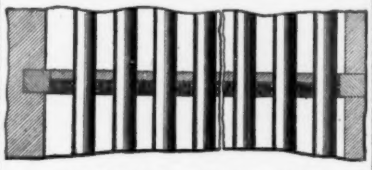
Machines and Mechanical Devices.

CONVEYER.—W. J. Turnbull, New Orleans, La. The invention has for its object to provide a perpendicular conveyer which can be operated efficiently for discharging cargoes from the hulls of vessels and which can be lowered from time to time as the cargo is discharged in order that the conveyer may be supported by the cargo as the latter is lowered during the operation of unloading.

AIR-COMPRESSOR.—J. Hanna and A. H. Hanna, Troy, N. Y. This invention relates to certain improvements in air pumps, and more particularly to a form of pump adapted to be secured to the chassis or other part of a motor vehicle to compress air to be used in conjunction with the starting device or the steering device, or to operate the brakes, or for the inflation of the tires, or other desired purposes.

Prime Movers and Their Accessories.

FLAME OR BAFFLE BRIDGE FOR WATER-TUBE BOILERS.—A. P. Gerald, 92 Poplar Street, Jersey City, N. J. In many forms of water-tube boilers, a flame or baffle bridge is mounted transversely of the tube so as to cause the flame or gases of combustion to travel between the tubes in one direction to the baffle, and then back between the tubes



HEAT RESISTING BAFFLE BRIDGE.

upon the opposite side of the baffle. The baffle bridges are usually made of tiles supported by a cast metal backing. This is frequently warped or burned away. The object of the present invention is to overcome this difficulty by using layers of tiles, including a series of strips of heat-resisting material.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Threshing machine, G. Sipler ... 976,306
Ticket holder, R. F. Polski ... 976,832
Timber impregnating apparatus, S. Willner 976,715
Time recorder, C. H. Koerber ... 976,375
Tire repairing device, E. A. Holcomb ... 976,262
Tire, spring, V. A. Marsh ... 976,667
Tire support, A. C. Hayden ... 976,736
Tire tightener, R. B. Smith ... 976,514
Toaster, F. E. Hoffman ... 976,364
Tool, combination, J. Middleton ... 976,674
Tools, centering and driving means for, S. H. Cox ... 976,346
Tooth, artificial, F. Z. Hanscom ... 976,798
Tooth crown, C. E. Coleman ... 976,153
Torch, N. J. Anderson ... 976,717
Toy, musical, E. J. Rich ... 976,695
Toy or puzzle, scientific, Jeans & Beevers.. 976,371
Toy railway rail, M. Caruso ... 976,633
Toy railway rail, J. L. Cohen (now J. L. Cowen) ... 976,722
Toy, sounding, W. Bartholomae ... 976,718
Trace carrier, S. W. Coffman ... 976,636
Traction members, apparatus for treating, E. M. Boynton ... 976,627
Transfer tube system, Skirrow & Needham. 976,753
Transportation, equalizer for wire rope, A. Horner ... 976,463
Trick chair, E. De Moulin ... 976,786
Trolley for electric cars, A. Del Valle ... 976,728
Trolley head, E. E. Duff ... 976,445
Trolley pole, P. Schnell ... 976,501
Trolley wheel, E. K. Harris ... 976,172
Truck, C. E. M. Miller ... 976,201
Truck for harvesters and binders, tongue, J. Flaig, reissue ... 13,169
Trunk, C. Billburg ... 976,339
Turbine, C. E. Hicks ... 976,260
Turbine blade, G. Westinghouse ... 976,418
Typewriter clamp, F. Roberts ... 976,397
Typewriting machine carriage, O. C. Kavle. 976,466
Umbrella attachment, G. D. Corey ... 976,638
Vacuum sweeper, Quist & Blanch ... 976,494
Valise locking device, D. Stamey ... 976,706
Valve, B. F. Silliman ... 976,222
Valve, W. S. Fairhurst ... 976,449
Valve, J. Nolan ... 976,489
Valve, G. Schuster ... 976,702
Valve, J. H. Hulings ... 976,804
Valve controlled device for drawing liquids, G. A. Robinson ... 976,398
Valve, engine, R. Wintzer ... 976,766
Valve gear, J. G. Blunt ... 976,542
Valve gear and ignition mechanism, J. H. Londick ... 976,478
Valve gear for fluid pressure motors, C. Hammen ... 976,458
Valve mechanism for steamboat engines, R. Eaton ... 976,790
Valve regulator, T. M. Wilkins ... 976,713
Valve stems, cap for renewing the worn ends of engine, J. A. McHardy ... 976,274
Vaporizer or carbureter, A. J. Stickler ... 976,409
Varnish, providing bronze powder and dust colors with a coat of, E. Oeser ... 976,594
Vault, burial, J. C. Simpson ... 976,407
Vault head, W. B. White ... 976,327
Vehicle, C. H. Washburne ... 976,413
Vehicle, motor, V. Link ... 976,193
Vehicle, power dumping, N. H. Nelson ... 976,389
Vehicle wheel, B. W. Hammond ... 976,360
Vehicle wheel, O. Treier ... 976,710
Vehicles, portable testing device for mechanically propelled, F. I. Spellman ... 976,705
Veil, automobile, J. V. Siegel ... 976,510
Ventilating system, J. C. Stroh ... 976,229
Vibratory apparatus for ear treatment, E. Meyer ... 976,200
Vise, fluid pressure actuated, J. E. Osmer.. 976,285
Vise, swivel base, E. M. Walker ... 976,521
Wagon loading device, W. W. Lucas ... 976,666
Wagon rack, adjustable, A. E. Sutherland. 976,614
Walking rake, W. F. & J. C. Bohling ... 976,250
Warp stop mechanism, J. K. Lanning ... 976,379
Washing machine, D. Hawley ... 976,362
Water-closet hinge connection, J. H. Pryor. 976,395
Water crib or caisson, F. P. Fensky ... 976,257
Water level regulator and indicator, G. Lane ... 976,741
Water-tight coupling, W. J. Donnelley ... 976,787
Weighing machine, P. J. A. Stockmann ... 976,228
Well packer, W. Hemme ... 976,737
Wheel. See Fifth wheel.
Wheel attachment, I. R. Thompson ... 976,315
Winding machine, cop, E. H. Ryon ... 976,698
Window, A. Wolff ... 976,534
Window construction, J. Roberton ... 976,297
Window frame, sectional metallic, W. D. Smith ... 976,308
Window operating and locking mechanism, F. Karsitz ... 976,575
Wing carrier, W. F. Brown ... 976,629
Wire twisting and weaving machine, J. Cevasco et al. ... 976,548
Wire edges, machine for making, H. Gansslen ... 976,353
Wrench, T. O'Hare ... 976,391
Wrench, S. A. Holman ... 976,740
Zinc, producing metallic, O. B. Dawson ... 976,557

A printed copy of the specification and drawing of any patent in the foregoing list, or any patent in print issued since October 4th, 1859, will be furnished from this office for 10 cents, provided the name and number of the patent desired and the date be given. Address Munn & Co., Inc., 361 Broadway, New York.

Canadian patents may now be obtained by the inventors for any of the inventions named in the foregoing list. For terms and further particulars address Munn & Co., Inc., 361 Broadway, New York.

Something About Pipe Covering.

(*Continued from page 436.*)

table fibers. The foundation substance may be prepared as follows: 15 parts of molasses, 25 parts of water-glass of 38 deg. to 40 deg. Bé., and 60 parts of water, are mixed together in a suitable vessel. In a trough, tub, or a half-cask, place 40 parts loam, 40 parts kieselguhr, 10 parts red iron ocher, 10 parts asbestos fiber, mix them first thoroughly while dry, then add sufficient of the molasses-water-glass solution, until, by very thorough stirring, a uniform mass of the consistency of the loam paste, used by the stove builder or mason for pointing up, is obtained. This foundation substance is applied by hand evenly to the object to be covered, so that a coating, about 6 to 10 millimeters thick, as rough as possible, but under no circumstances smooth, is produced. Before all the objects to be protected in a place have been covered, those at first coated will be dry, so that one can proceed at once with the second coating, for which is used the second heat-insulating mixture. This is prepared by stirring 20 parts of loam, 70 to 75 parts of kieselguhr, 5 to 10 parts of asbestos fiber, or 2½ to 5 parts of cow hair, into a 3 to 5 per cent solution of glue and 10 parts of water-glass, until in consistency it is exactly the same as the first mass. The coating with the second mass is effected the same as with the foundation mass; consequently the coatings each time must never be more than 7 to 10 millimeters thick.

The applications are repeated so often that, according to need or desire, a covering of 2½ to 4 centimeters is formed; but in no case must a new application be made until the preceding coating is dry. The coating, as far as possible, must be of uniform thickness, the last application level and smooth, so that the covering has a presentable appearance. We then dissolve, in 3 parts of hot water, 1 part of dextrine, and 1/10 part of starch syrup, with which the covering is by no means sparingly painted, by means of a brush, and not all the objects at once, but just one surface, say one pipe. In the meantime, in a smaller vessel, strips of cheap glazed lining fabric, about 10 centimeters wide, which may have a length of a few meters, have been soaked in the same solution, with 2 parts of dextrine solution thinned with water, so that they are quite saturated with it; they are then rolled up like bandages and wrapped, following a serpentine course, about the coated pipes. The skill of the workman must be depended on to lay the covering on evenly and without wrinkles even with crooked or bent pipes or joints. The strips should overlap one another 1 to 2 centimeters so that no part remains that is not enveloped, and the entire layer of insulation is covered. Flat, or large round objects, like boilers, etc., are covered, in place of strips, with properly fitted pieces of lining fabric. Pipe lines that are in the open air and exposed to the effects of the weather, are covered, in place of with the fabric, with roofing felt, cut suitably broad and long. The sticking on with dextrine, is of course omitted here and the felt is secured by means of wire. In order that the insulation at the end of the pipes may be protected as far as possible and the lining fabric or roofing felt may not be frayed out, the ends may be covered with strips of tin, about 3 centimeters broad, also secured by wires. Whatever of the insulation projects beyond the tin edging is cut off smoothly with a knife and to give it a neat appearance, as well as to insure its durability, the cut surface is coated with the foundation mass. For the roofing felt covering, a cheap tar-paint or asphalt varnish is applied. Where the pipes are connected up by flanges, sleeves, or joints, and it is perceived that they are liable to be taken apart at these points or tightened, a suitable space must be left and the coating so disposed that in taking apart or tightening up it will not be in the way.

Finally, we have to consider the pipe

covering effected by means of straw braids and insulating rope. The best known, cheapest, and possibly the oldest is the covering of straw. Rye straw is moistened by spraying with water and then woven into long braids. The conductor pipes are then wound with the braids spirally, but not too closely, so that about 1 centimeter of interspace is left; then the whole thoroughly plastered with clay paste, in which cow hair and chopped straw have been mixed, so that the interstices between the straw braids are plastered up, a layer of the clay, 1 to 2 centimeters thick, forming a covering. This insulation is neither sightly, nor, especially on hot steam pipes, durable.

Much better adapted for this purpose is the covering rope, to be obtained ready made, of 2 to 5 centimeters in thickness, from engine-packing or insulating-material manufacturers. Asbestos insulating rope made from spun asbestos and kieselguhr is suitable for hot conductor pipes, whereas for cold or only warm-water conductors jute rope suffices. This form of covering is carried out in the same manner as with straw braids, only the rope-coils are laid up close together and sometimes the plastering with clay is omitted. According as the covering is executed, protected, and cared for, it will last, irrespective of possibly necessary repairs, for several years, so that the expenditure of money and labor will be abundantly repaid.—Translated from Der Chemisch-Technische Fabrikant.

ELECTRIC HOT-WATER SUPPLY SYSTEM.

(*Continued from page 437.*)

rially in the present methods of generating electricity. In seeking to cheapen electricity supply by improving the load factor, attempts have been made to store electricity at the central station, as gas is stored at the gas works. But the electric storage battery, possible to use for this purpose, but not practicable on any large scale, is available only for the direct current; for the alternating current, which is generated in by far the largest number of stations nowadays, there is no means of storage.

The new electric system of hot-water heating is designed to solve the load factor problem by taking current at times convenient to the generating station to deliver the last, while delivering to the consumer electrically heated water at any time convenient to him to utilize the hot water. It proposes to accomplish this by storing, not electricity at the central station, but heat on the consumer's premises; taking from the mains the current for generating the heat only during the daylight hours, when the lighting load is small, and thus by arrangement with the electricity supply company securing a special, low rate for current; since the full amount of machinery for the maximum demand for light must be installed anyway, and the company is naturally desirous of operating its machinery at its full capacity all the time.

The apparatus consists of a heating element taking a comparatively small current and placed in the center of a heavy block of cast iron. The last is cast around a coil of iron pipe, one end of which is connected to the house water piping, the other end of the coil being brought out at a special faucet. Surrounding the iron block is a thick wall of heat-insulating substance to hold the heat from escaping; any heat that does get through this lagging being taken up by a wall of water surrounding the same. Outside of all is another wall of lagging, so that almost literally none of the electrically generated heat is lost.

In operation, an automatic time switch turns on the current only during the load period each day, when the demand for current for lighting is small. By the long-continued heating effect of the current the temperature of the iron block is raised to about 500 deg. F., so that water entering the coil immediately becomes steam. A by-pass pipe leads to the faucet directly from the house piping, and by turning the handle of the faucet to various angles the cold water that flows through the apparatus is mixed with steam in varying proportions; the mixing faucet thus delivering water of any desired temperature from tepid to boiling. An apparatus of 300 kilowatts capacity, cylindrical in shape and two feet in diameter and in height—a size adapted to ordinary household use—will deliver 30 gallons of water at 110 degrees temperature, as for a hot bath, ten hours after the current has been turned off.

The same principle is applied to cooking, employing a composite utensil of snugly fitting receptacles for individual articles of food, the whole inclosed in a single removable, heat-insulating cover.

MOTOR-DRIVEN PLOW AND CULTIVATOR.

(*Continued from page 437.*)

miles, the second and third being concentric cross shafts, moved by bevel gears, one actionating the revolving drum by two successive chain drives, the other carrying the pulley outside of the frame, allowing for driving other machinery.

The frame is supported by three wheels. The front wheel is set in a fork, which supports the insignificant front weight by means of a spiral spring, and by a steering gear of the usual type can be made to turn to an angle of 180 deg. The wheel is fitted in the middle of its rim with a rib, facilitating greatly the exact direction of the machine. The back wheels have a diameter of 4 feet 8 inches and are 1 foot 6 inches wide, that amounts to a proportion of running surface of 1,000 square inches, so that the specific pressure per square inch projection surface is not more than 3½ pounds, which figure has never been realized before in any traction engine, which is the reason why the machine runs without any difficulty over the softest ground. The wheels are laterally closed by thin steel plates, to prevent their becoming clogged with mud.

A specially large radiator (cooling surface 300 square feet) is set in front of the motor, and a gasoline tank having a capacity of 40 gallons is placed under the driver's seat. The slowest rate of speed is used only in exceptional cases, when the ground is very hard or heavy, or when a great depth (up to 1½ feet) is desired. When the ground is of medium hardness or not extraordinarily heavy, the normal speed of one mile per hour is used to a depth of one foot. The speed of two miles per hour is employed in loose or sandy ground or where sod or stubble is to be broken up (peeling). When traveling on the road, the highest speed of four miles is used. The proportion of the number of revolutions of the drum to the advancing speed of the car, which decides the thickness of the clods, is constant for every rate of speed, which means a variation of drum revolutions from 25 to 100 clods of any thickness desired, is obtained by changing the pinion of one of the abovementioned chain drives between the gear box and the drum.

By a combination of the steering gear with the two brakes on both back wheels, and owing to the fact that the machine is fitted with a differential, the car can be turned in its place, pivoting around one of the back wheels in two seconds, thus being in a position to begin to work a new strip of ground, losing no time in unnecessary maneuvering, and leaving no space between uncultivated ground.

The drum in the rear of the car, which may be lowered or lifted to a suitable distance from the earth, from the driver's seat, revolves on ball bearings around a shaft, which by means of two tubular brackets forms a rigid frame with the rear axle. The drum consists of its hub with two circular steel plates, one fixed on each end. In these steel plates are inserted four hoe shafts, which turn in suitable bearings and carry the hoes, flexibly attached to them. Each hoe is made up of the following parts, all of pressed steel: a holding piece clamped

upon the upper half of the shafts, rigidly welded together with two side sheets, forming the hoe spike and terminating in the head piece. This piece is fitted with two bolts, against which the hoeing tool itself is pressed by a spring fixed between the two side sheets. The above-mentioned holding piece is held on the shaft by a spiral spring, wound around, allowing for a flexibility in any direction, while the spring, fixing the tool itself, permits giving away forward or backward and swiveling sideways, to avoid any obstacles, such as stone, roots, etc., and later compels the tool to return to its original position.

The force actuating the hoes when the drum rotates is the centrifugal force combined with the gravity. The regulation of the phase and the energy of successive blows is done by a latch mechanism, permitting the hoes to swing out at the right moment and catching and holding them again, after having performed this work in the ground. The drum has a diameter of 3½ feet. In front of the main driving tool may be placed a dovetailed forecutter, suited to cut the top grass clod and to tear it down into the spaces opened by the main knives in order to have it buried under the clods. Upon one hoe shaft from 16 to 24 hoes can be placed side by side in the actual type of machine, allowing for working a strip 7 to 8 feet wide, sufficient for three rows of corn, cotton, or potato plants.

According to the work to be done, the hoes can be changed; light against heavy ones, pointed against flat ones, long ones against flat-working ones (peeling). The changing is done by hand, without unscrewing any bolts and without requiring any special tools.

With one man to operate it and with a gasoline consumption of two to three gallons per hour, the following work is performed by the machine:

	Depth, Inches.	Output, Acres per Hour.
As peeling machine....	3 to 4	1 to 2
Hoeing machine.............. ..	6 to 8	½ to 1
Hoeing machine................	8 to 10	0.45 to 0.90
Hoeing machine................	10 to 14	0.40 to 0.80
For very hard and heavy ground, where plows and motor traction are unfit to do any work...........	6 to 8	0.40 to 0.80

Studying these figures, it must be considered that the machine renders the soil ready for sowing, and it hauls any roller or sowing machine attached to it, when performing its work.

SCIENTIFIC BREEDING OF ANIMALS AND PLANTS.

(Continued from page 440.)

compared in a far more vital way than by simply comparing their yields.

This centgener method of breeding was originated by the Hon. W. M. Hays, Assistant Secretary of Agriculture, who stands at the head of a group of men who are conquering a new earth. More than twenty years ago he began experimenting with our field crops, trying to increase their yield, and his unique methods have been developed into a system with a most wonderful organization of detail in selecting seeds, planting large broods of single mother plants, recording the performance of individual plants, and in tabulating and displaying the pedigree values of the thousands of newly created pure-bred varieties, which is now recognized as the most important method followed by scientific breeders.

Interest in this new science has been awakened all over the country, as is evidenced by the fact that establishments whose task is to create new heredity values are being built in many of our States. Minnesota, Nebraska, Iowa, Colorado, Wisconsin, North Dakota, South Dakota, Kansas, Ohio, and a number of other States are actively engaged in forwarding this work. The United States Department of Agriculture is developing specialists, each trained in breeding certain species, who are co-operating with

all public institutions and also with private breeders in this work.

This great national movement to promote scientific breeding also led to the formation of the American Breeders' Association, an organization which has more than fifty committees at work on the different phases of plant and animal breeding. It has committees on breeding draft horses, driving horses, saddlers, dairy cows, beef cattle, and dual-purpose or double-decked cows, good for both beef and milk; committees which deal with the improvement of sheep, swine, poultry, pet stock, fur-bearing animals, and game birds, also committees which formulate the best plans for the breeders of wheat, of corn, and of alfalfa, and in fact on all questions relating to the breeding subject. Under the leadership of this association, in conjunction with the United States Department of Agriculture and the Minnesota Experiment Station, a co-operative association of breeders has been formed, whose object is to create and distribute new breeds and sub-breeds of animals. Certain territories called "circuits," comprising twenty or more breeders, are each under the care of a superintendent, whose salary charge is evenly divided between the association, the Experiment Station, and the Federal government. It is his duty to travel around among the breeders and aid them in breeding their herds, and also to find where they can purchase the best foundation stock to be secured in this country or abroad. Each breeder in return for this public service agrees to work under the rules of a board of three, consisting of a representative of the association, the station, and the department. Each co-operator signs a bond to own and breed at least five females and one male of type approved by the board, to feed and manage them in accordance with the will of this body, and to sell stock of the first class only to other members of the association. Animals not chosen to breed in the circuit may be registered in the national register for this breed, and sold to outside breeders of pure-bred cattle, but defective animals must either be destroyed or sold only to breeders of common cattle. This plan avoids public ownership, and allows each breeder, within certain limits, to conduct his own business.

These men who are harnessing up and using the forces of heredity have already added vast millions to the wealth of the country, as already stated. The potato originated by Luther Burbank in his boyhood has yielded probably the largest aggregate of additional wealth of any new things created. Other men like him have braved derision, discomfort, and privation to demonstrate their belief in the subtle forces of heredity. Not less than a million dollars may be found on the balance sheets of the orchardists of the Northwest by the creation of a single variety of apple, called the "Wealthy," whose peculiar heredity enables it to thrive farther north than any other apple. It was originated by a man named Peter Gideon. A variety of wheat known as "Minnesota No. 169," which yields nearly twenty bushels an acre more than ordinary wheat, was originated at the Minnesota Experiment Station, and has now spread to more than a million acres, increasing our wheat wealth millions of dollars. The flax "No. 25" of this same station yields twenty-five per cent more seed than ordinary flax, and has crowded its parents from hundreds of thousands of acres of land. Corn "No. 13" is now so widely used that it has, owing to its hardiness, carried the corn belt fifty miles farther north than it was before this variety was originated.

The breeding of field crops has greatly enlarged such industries as flour milling, dealing in grain, the making of linseed oil, and also the cattle business, for more corn makes more cattle, and all this increased production and work increases the number of people in the State and increases the per capita wealth.

In animal breeding too there have been

amazing achievements. Longer years, however, are required in this field for accomplishing results. Special breeds of bacon hogs, with long sides of uniform thickness with alternating layers of fat and lean, have been created through the efforts of the Minister of Agriculture of Ontario, Canada, in his efforts to gain in England a market for Canadian pork.

The growers of cattle and users of meat have had a great wealth brought to their barns through the far-seeing patience of Cruikshank, the originator of the famous Shorthorn cattle, noted for their superior meat-producing qualities. In Colorado there is now being bred a type of horse peculiarly fitted for both carriage and heavy driving vehicles, through the efforts of Prof. Carlyle, with help from the Federal Department of Agriculture. The nucleus of this new breed is on the agricultural college farm, but the ranchmen of Colorado are aiding in the work of implanting on the State's vast horse-raising area these large, beautiful, and enduring drivers, for which there is an ever-growing demand, both in domestic and foreign markets, notwithstanding the popularity of the automobile.

The governments of the world now consider expenditures for building up the science and the practice of agriculture and the work of creating better types of plants and animals as necesary as expenditures for an army and navy. By both selective and creative breeding, in part under public patronage, increases will continue to be made in the value of our plant and animal productions equal to our military, naval, and educational expenditures. And without increasing our cultural acreage, there will be plenty of food for as many millions as we are likely to have—all through this new science of breeding.

TYPEWRITER OPERATING WITHOUT NOISE.

(*Concluded from page 441.*)

surface, flat-faced type are used instead of the ordinary concave type. This overcomes a difficulty common to machines using a rubber roll for the platen in which the diameter of the printing surface varies with the number of copies made, resulting in blurred impressions when the curvature differs materially from that of the type.

In order to produce a noiseless typewriter, it is necessary not merely to keep the key and typebar movement quiet, but to make the escapement, shift, and back spacer movements silent, as well. This result has been accomplished by the use of ratchet pawls and dogs fitted with cam surfaces so that there is no clicking noise whatever. The escapement mechanism is very ingenious. The pinion at the upper end of the escapewheel shaft engages the carriage rack and must be capable of movement to allow for adjusting the carriage toward and from the printing position, as explained above. The escapement pawl, however, is mounted in the fixed part of the machine. In order to allow for such relative movement the shaft is mounted on a globular ball-bearing; that is, the cones of the bearing are spherical, so that there will be no binding, whether the upper part of the shaft is moved forward or to the rear and out of the normal vertical position. The silent cam-faced escapement pawl is clearly shown in one of the detail views. Everything has been done to hush the slightest click. Even the bell that gives warning when the end of a line has nearly been reached makes a very faint "ting"; but this sound is amply loud, considering the silence of the rest of the machine.

Copying Old MSS.—To make old writings plainly legible for copying, dissolve 150 parts of oxalate of ammonia, of potassium, or of sodium, 0.8 part of ferrocyanide of potassium; 0.06 part of vanadate of ammonia in 1,000 parts of water, and when copying use this solution to moisten the faded places.